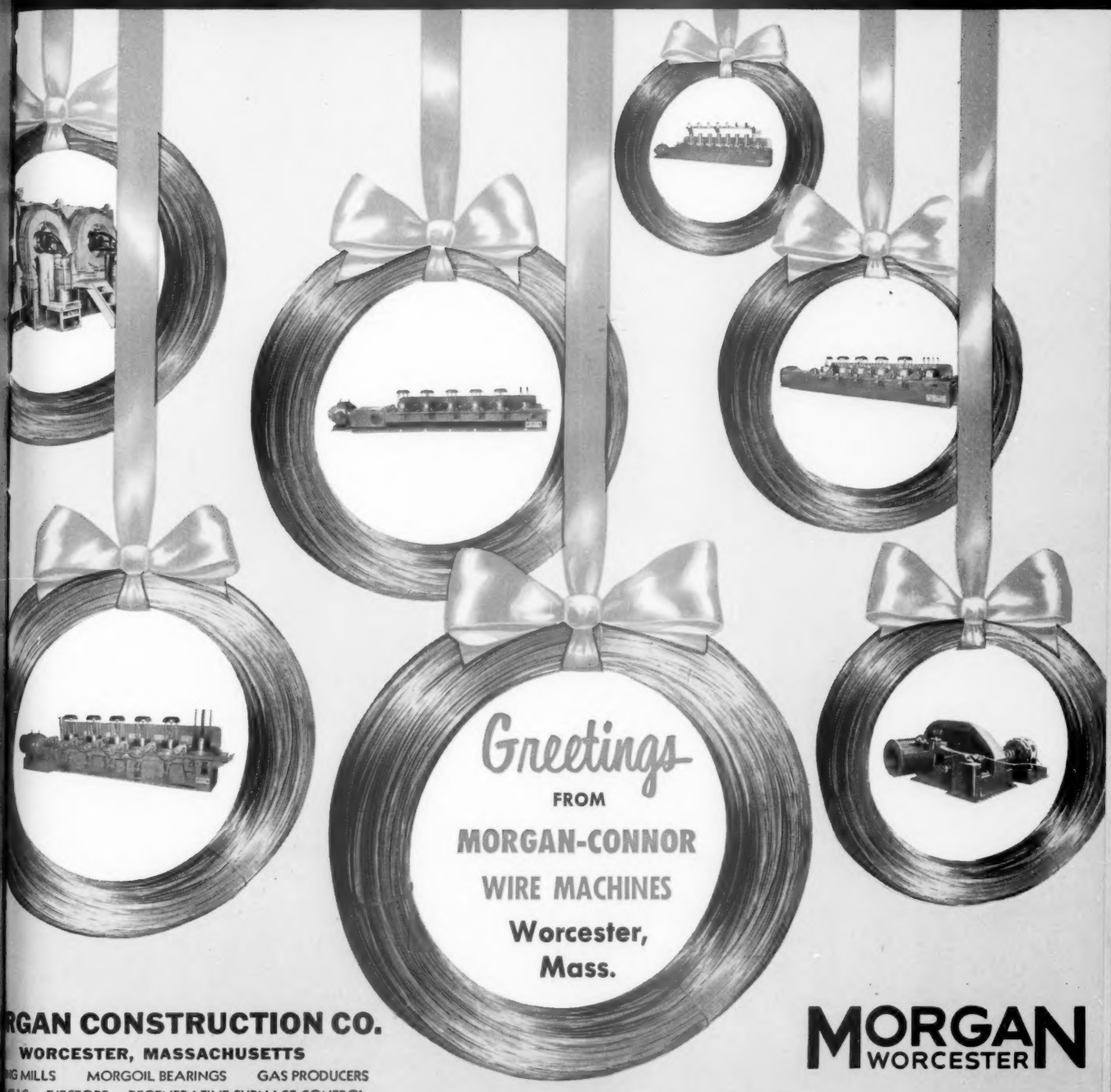
# WIRE AND WIRE PRODUCTS

DECEMBER 1959




RGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS
NG MILLS MORGOIL BEARINGS GAS PRODUCERS
ILLS EJECTORS REGENERATIVE FURNACE CONTROL

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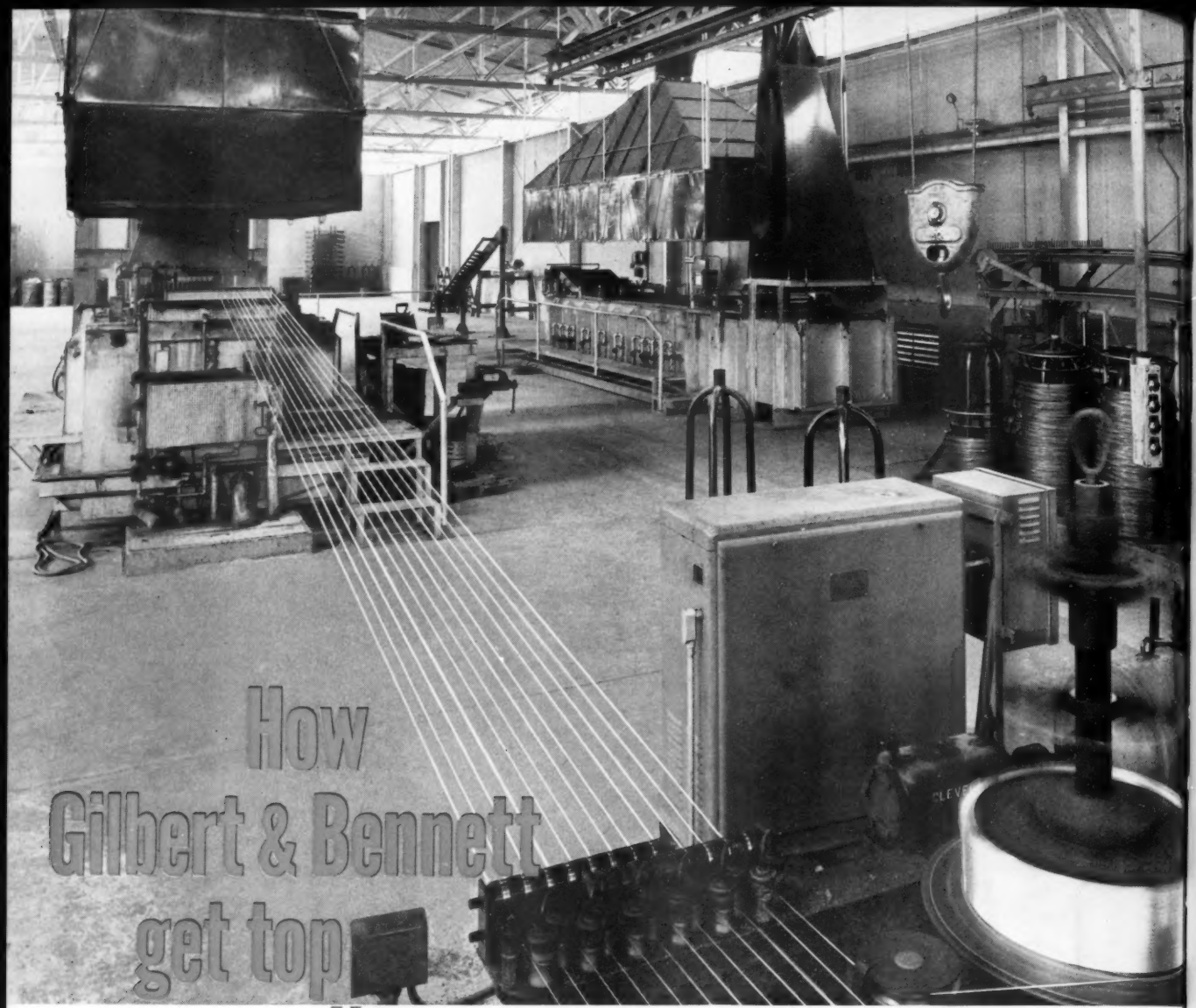
FICIAL PUBLICATION OF THE WIRE ASSOCIATION



# How Gilbert & Bennett get top quality galvanized wire...fast!

## *New Lee Wilson* line anneals, cleans and coats in one continuous operation—

The new Lee Wilson Continuous Lead Annealing and Galvanizing line was recently set into operation at Gilbert and Bennett Manufacturing Company's Blue Island, Illinois plant for volume production of galvanized wire. The entire line from pay-off reels through lead annealing, acid rinse, zinc coating to take-up reels was engineered to a minimum of floor space while producing 2400 pounds of coated wire per hour. It will carry a maximum of 12 strands simultaneously.

Lee Wilson Annealing and Galvanizing lines are engineered around the principle of radiant tube heating. This method, pioneered by Lee Wilson engineers, permits far more accurate heat control, cuts drossage in half and doubles pot life. Because all combustion is completed in the alloy elbow, flame impingement on pit walls is eliminated, and there are no overheated areas to cause boiling of dross.

*Lee Wilson*
**ENGINEERING COMPANY, INC.**
20005 LAKE ROAD • CLEVELAND 16, OHIO

HIGH CONVECTION ANNEALING FURNACES
***MAKE THE BEST METALS BETTER***

*ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNA

# Greetings of The Season

***At this Season of the Year, when hearts are lighter and the warmth of brotherly love is universal, we of Standard Industrial wish our many, many friends, customers and customers-to-be, the Merriest of Christmases and a most Prosperous New Year.***

It is with a great deal of satisfaction that the Year of 1959 can be reviewed—it has brought us all new friends and successes, yet in spite of some trials, tribulations and, yes, even failures—we can still smile and rejoice.

Our best regards to the most wonderful group of men in the world—you wire men! Thank you for your many kindnesses and your unfailing courtesy to us.

*Sincerely,*

*Standard Industrial*
**COMPOUNDS CO., INC.**

**FRANKFORT, ILLINOIS**
**Telephones: 2131-2141**

**Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.**

# BLANE 2100 COMPOUND

**WHY WAS IT CHOSEN BY MAJOR AIRCRAFT MANUFACTURERS FOR JET PLANE WIRING?**

Because Tests show Blane #2100 provides the most insulation resistance over the full operating temperature range of any insulating material.

BLANE #2100 is specifically designed for use as a primary insulation in applications such as MIL-W-5086, MIL-W-16878A, and NAS-702 requiring temperature ranges from 105°C to −55°C. This quality material combines excellent high temperature properties with superior low temperature characteristics recommended for thin wall insulations.

These important features, plus outstanding electrical properties, make this smooth processing compound applicable for many government specifications including jet aircraft, missiles, rockets and machine wiring.

We suggest you examine Blane #2100 Compound yourself. Write for technical data, samples and information on applications.

## THE BLANE CORPORATION

CANTON, MASS.

# NON-RETURNABLE

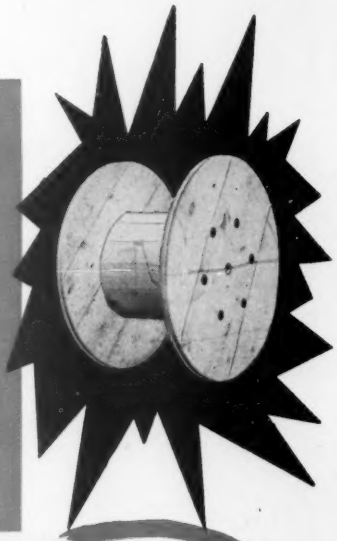
**WOOD REELS IN ALL SIZES FOR ALL TYPES OF ELECTRIC WIRE AND CABLE . . .**

B. J. —

This looks interesting to us in Production. Suggest you investigate Bridge Reels today. Advise me when you hear from Bridge

A. J. G.

# YES



## YOU SAVE WITH NON-RETURNABLES

**LOOK AT THE ADVANTAGES**

- **Reduce Reel Investment**
- **Less Storage Space**
- **Lower Freight Cost**
- **No Bookkeeping**
- **No Repair Costs**
- **No Return Freight**
- **No Deposit**
- **No More Headaches**

NON-RETURNABLE REELS GIVE YOU A DEFINITE PACKAGING COST

**HIGH SPEED**
**SHIPPING SERVICE IN OUR OWN TRUCKS**

within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels within a few days east of the Mississippi.

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***"REEL GOOD . . .***

Let us quote on your reel needs. Send us your specifications. Better yet, visit our plant and see how and why Bridge reels are made so well at so low a cost.

***WOOD REELS"***

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## FEATURES

1. TURNTABLES COMPLETELY ENCLOSED.
2. BALL JOINT MOUNTED GUIDE SHEAVES FOR ALL ANGULAR SETTINGS.
3. ELECTRO-MECHANICAL TENSION CONTROL FOR EACH HEAD.
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5. PRIME RUBBER LAGGED CAPSTAN.
6. ASSEMBLED AND ALL ADJUSTMENTS MADE WITH ALLEN SCREWS.
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8. INDIVIDUAL MAINTENANCE ON EACH SECTION.

The drum packaging Take-Up System illustrated, Model S5-TC-S, was designed especially for Magnet Wire.

Other models are made for all types of ferrous and non-ferrous wires.

Advanced engineering and precision construction have evolved in this machine new concepts of speed and efficiency in the packaging of wire. Capacity: Min. size — #32 ga.; max. size — #20 ga. wire.

**YOU ARE INVITED TO SECURE COMPLETE DETAILS REGARDING THIS ADVANCED PROCESS FROM —**

## Advanced Wyrepak Co., Inc.

11 HARRISON COURT PHONE: EDison 4-4274 BRIDGEPORT, CONN.

OR The Vaughn Machinery Co., CUYAHOGA FALLS, OHIO

# WIRE AND WIRE PRODUCTS*

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 34 December, 1959 No. 12

Designated as Official Publication By The Wire Association


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What kind of cut do you get with your present cutting tool?

A clean cut?

An easy cut?

Do these qualities last after the tool has been in use a few months?

CAREW Cutters may not be the solution to every cutting problem, but they are to many.

CAREW Cutters and replacement jaws are stocked by most mill supply dealers. Try some, and feel free to write us on your Cutting Problems.

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ROCKFALL, CONN., U.S.A.

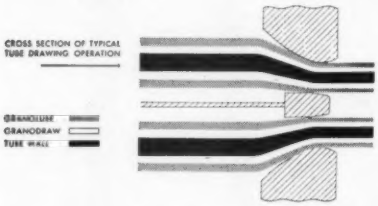
96 YEARS OF CUTTING WIRE AND COSTS

AMCHEM Information Bulletin

# CHEMICAL CONVERSION COATINGS and their functions in facilitating the cold mechanical deformation of metals

By ARTHUR DAHL, Product Development Dept., AMCHEM PRODUCTS, INC.

When used to facilitate the cold mechanical deformation of metals (in drawing, extrusion, stamping, cold heading, necking, and upsetting operations) chemical conversion coatings in conjunction with suitable lubricants perform three important functions. One, they prevent metal-to-metal contact between work and tool. Two, they prevent galling and seizing. Three, they protect stock indefinitely, permitting the storage of in-process work at any stage of production, without danger of corrosion damage.




Characteristic of the tightly bound, highly absorptive, crystalline coating formed by the processes is the ability of the coating to retain lubricity throughout forming operations when treated with a suitable lubricant. This offers the following production advantages:

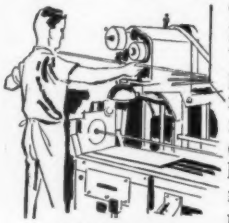
- **Higher degree of reduction**
- **Greater speed of draw**
- **Longer tool life**
- **Fewer process anneals and pickling**
- **Finer surface finish**
- **Cleaner mills**
- **Easier inspection of finished product**

Also of interest to production men is the exact duplication of coatings from batch to batch. And the processes are much simpler than other methods of coating metals—baths can be set up and running in less time than it takes to determine suitable coatings by other methods.

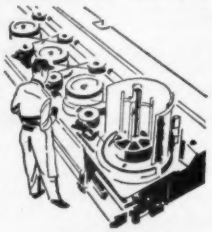
## TYPES OF COATINGS AND THE METALS FOR WHICH THEY ARE DESIGNED

**Zinc phosphate coatings for carbon steel.** These coatings can be applied by either dip or spray systems.

**Dip.** Amchem Granodraw No. 1 is typical of the dip process. The sequence includes precleaning, water rinse, pickling, water rinse, water rinse, Granodraw No. 1 solution, water rinse, and a hot neutralizing rinse. Surfaces to be treated must be free of oil, grease, rust and scale. The above sequence insures that they will be. And when metal is free of rust and scale, the pickling bath and two succeeding water rinses can be omitted. In either case, a lubricant like Amchem Granolube or conventional lubricant must be applied prior to working the metal.

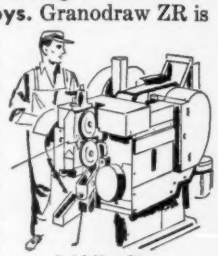

Tube Drawing

**Spray.** Amchem Granodraw No. 4 is an example of the spray process. It usually requires 5-stage equipment and includes the following steps: precleaning, water rinse, Granodraw No. 4 solution, water rinse, lubricant. After chemical treatment, the work must be dried before forming.

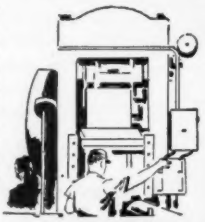

Wire Drawing

**Oxalate Coatings for the stainless steels and many of the high-nickel alloys.** These coatings are applied only by immersion process, and usually in a 5-stage system which includes an acid pickling or depassivating bath, a water rinse, the Amchem Granodraw SS coating bath, a hot borax neutralizing rinse for wire stock, or a lubricating bath for tube stock. Since thorough activation of the metal surface is necessary to promote an adherent coating, the pickling and activating bath is an important stage in processing.

**Fluoride-type coatings for zirconium and its alloys.** Granodraw ZR is such a coating. It is applied in an immersion process which includes precleaning, water rinse, pickling, water rinse, Granodraw ZR solution, water rinse, drying or lubricating. It has been used primarily in the treatment of stock prior to wire drawing and tube drawing. Surfaces are cleaned of oil and grease by solvent degreasing or alkali cleaning. Pickling is required to provide a surface that is chemically and metallurgically receptive to the coating.


Cold Heading

**Amorphous phosphate coatings for aluminum.** This type of coating is now in the development stage. Laboratory and field tests are being conducted, results are being evaluated, and modifications in chemical make-up and process sequence are being made to meet requirements. Several field tests, however, have indicated that it will do the same job for aluminum processors as the other types of coatings have done for those working carbon steel, stainless steel, high-nickel alloy, and zirconium.


Impact Extrusion

*For more information write us at Ambler.*

AMCHEM AMCHEM PRODUCTS, INC. (Formerly American Chemical Paint Co.)
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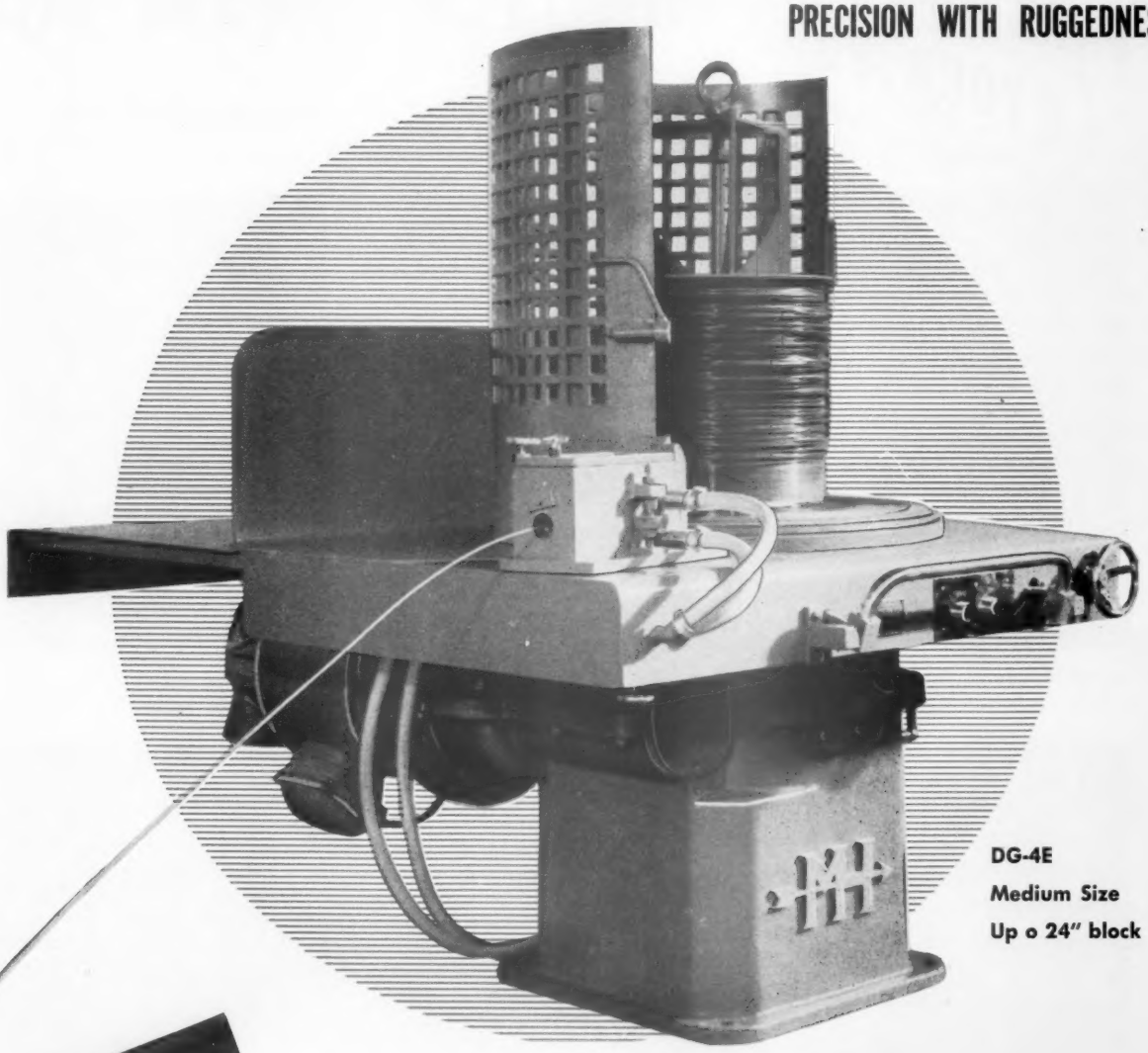
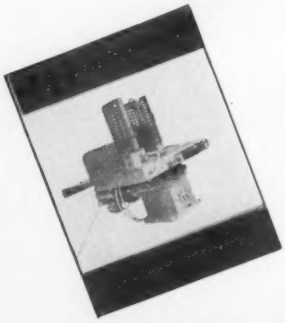
# BULL BLOCKS

## SINGLE or DOUBLE DECKED

PRECISION WITH RUGGEDNESS



DG-4E
Medium Size
Up o 24" block



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# CF&I WIRE HELPS

***"CF&I-Wickwire Wire Spiders give us 25% increase in productivity...20% less downtime... 80% less scrap loss," says Mr. Robert Mangold, Production Superintendent.***

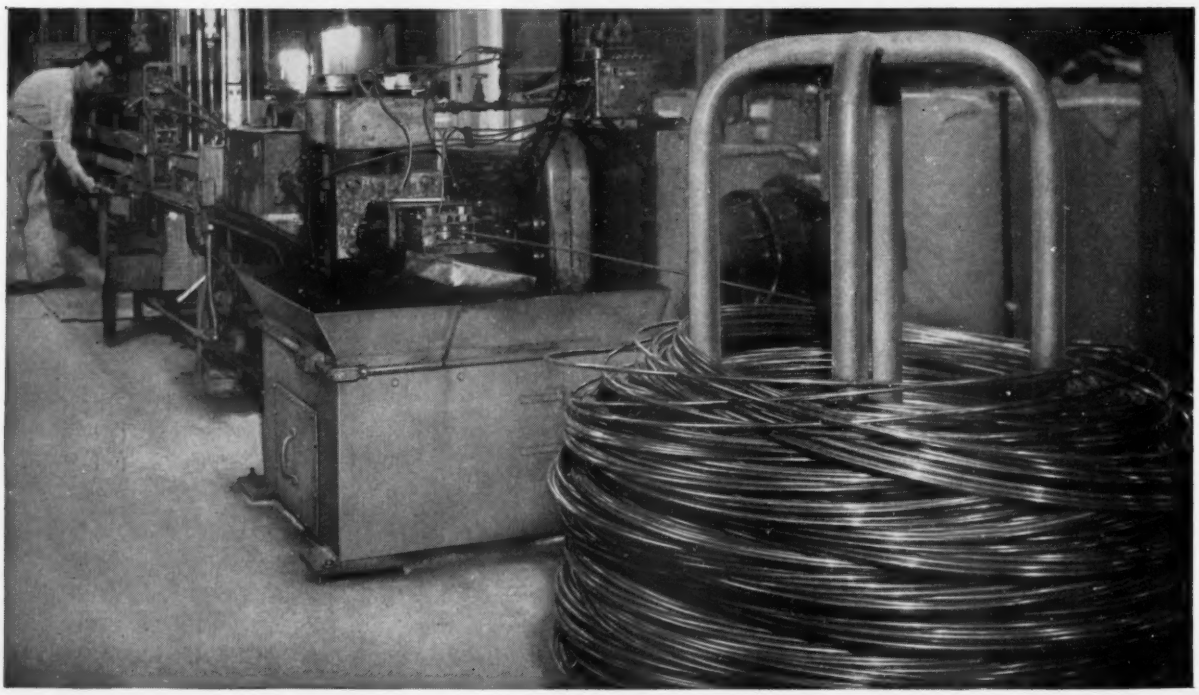
**25% Increased Production**—"Previously it required fifteen or twenty minutes to reset *each* of the eight to ten small coils used to feed our forming machine," explained Mr. Mangold. "For every eight hour shift, we lost two hours of production. Now with CF&I Spiders—which hold up to a 3000 lb. continuous length of wire—we change coils only once each shift. We save two hours per shift."

**80% Less Scrap Loss**—"Waste is an important consideration because we lost several feet every time we changed coils. Now we use only one and one-third CF&I Spiders each shift—instead of the eight or ten coils used previously—and have cut our waste 80%."

**Increased Safety**—"With small coils there was always the danger of the finishing end springing loose while rotating and striking equipment and personnel. With heavy-weight CF&I Spiders which revolve on a turntable while our machine withdraws the wire, the finishing end is securely anchored, reducing the possibility of tangling and eliminating this danger."

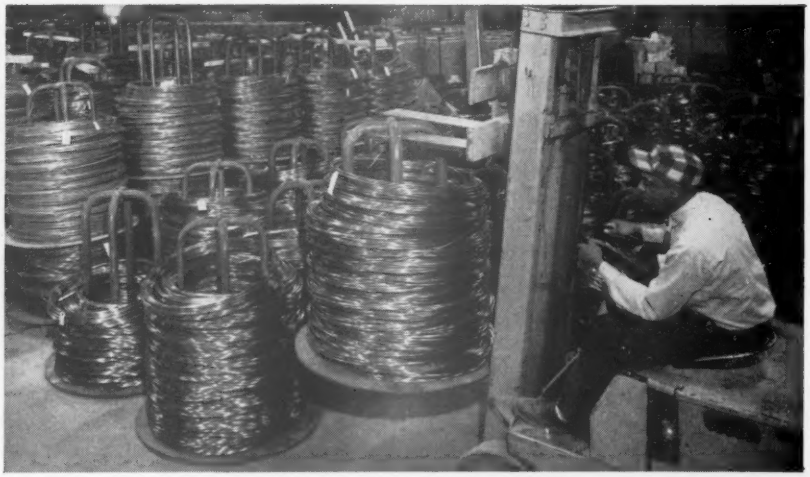
**Improved Quality of End Products**—"Since we do not have to reset the machine ten times a shift, the quality of our product is more uniform and we have fewer rejects," declared the superintendent of production. For a continuous operation, the end of one Spider can be butt welded to the start of another.

**Reduced Handling Costs**—"These sturdy Spiders have reduced our handling and storage problems, because each



# INCREASE PRODUCTION 25%, CUT MANUFACTURING COSTS

## *At Bridgeport Brass Co., Flemington, N. J.*



Spider contains as much wire as eight small coils. Unloading is safe and quick—one man with a fork lift can do the job easily, freeing several men for other important operations," Mr. Mangold pointed out.

**Simplified Inventory Control**—No need to sort through piles of wire coils...simply count the number of upright Spiders.

**Save Storage Space**—Spiders are stored compactly, requiring much less space than cumbersome coils. For maximum economy of space, Spiders can be doubled-decked which is equivalent to stacking 20 mill coils of 300 lbs.

Every CF&I Wire package offers one or more of the following benefits:

- **Reduced downtime through extra long continuous lengths of wire**
- **Simplified inventory control**
- **Fast, economical unloading and in-plant handling**
- **Continued cleanliness of the wire**

A CF&I representative will be glad to discuss your operation with you and recommend the wire package that will help save you time and money.

# CF&I-WICKWIRE WIRE

**THE COLORADO FUEL AND IRON CORPORATION**

*In the West:* **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso • Farmington (N. M.) Ft. Worth • Houston • Kansas City • Lincoln • Los Angeles • Oakland • Oklahoma City • Phoenix • Portland • Pueblo • Salt Lake City • San Francisco San Leandro • Seattle • Spokane • Wichita

*In the East:* **WICKWIRE SPENCER STEEL DIVISION**—Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia

**CF&I OFFICE IN CANADA:** Montreal

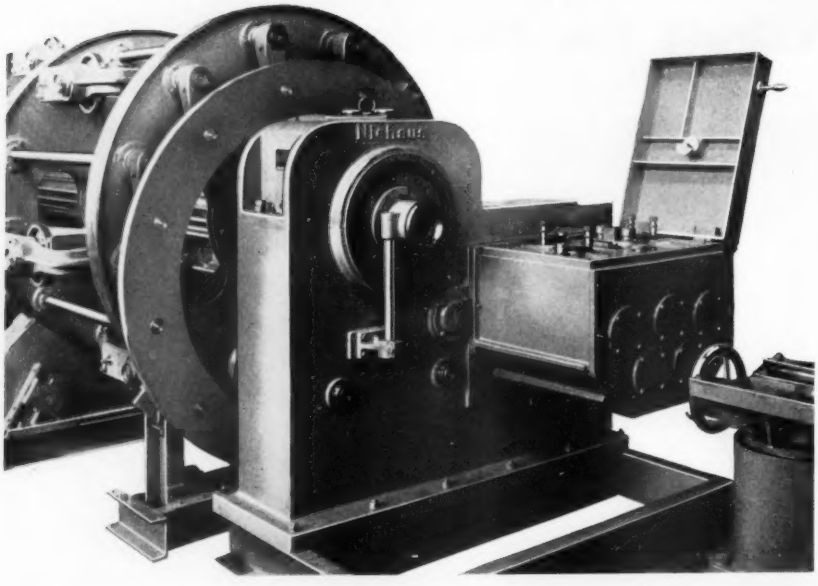
**CANADIAN REPRESENTATIVES AT:** Calgary • Edmonton • Vancouver • Winnipeg

6930

# NIEHAUS

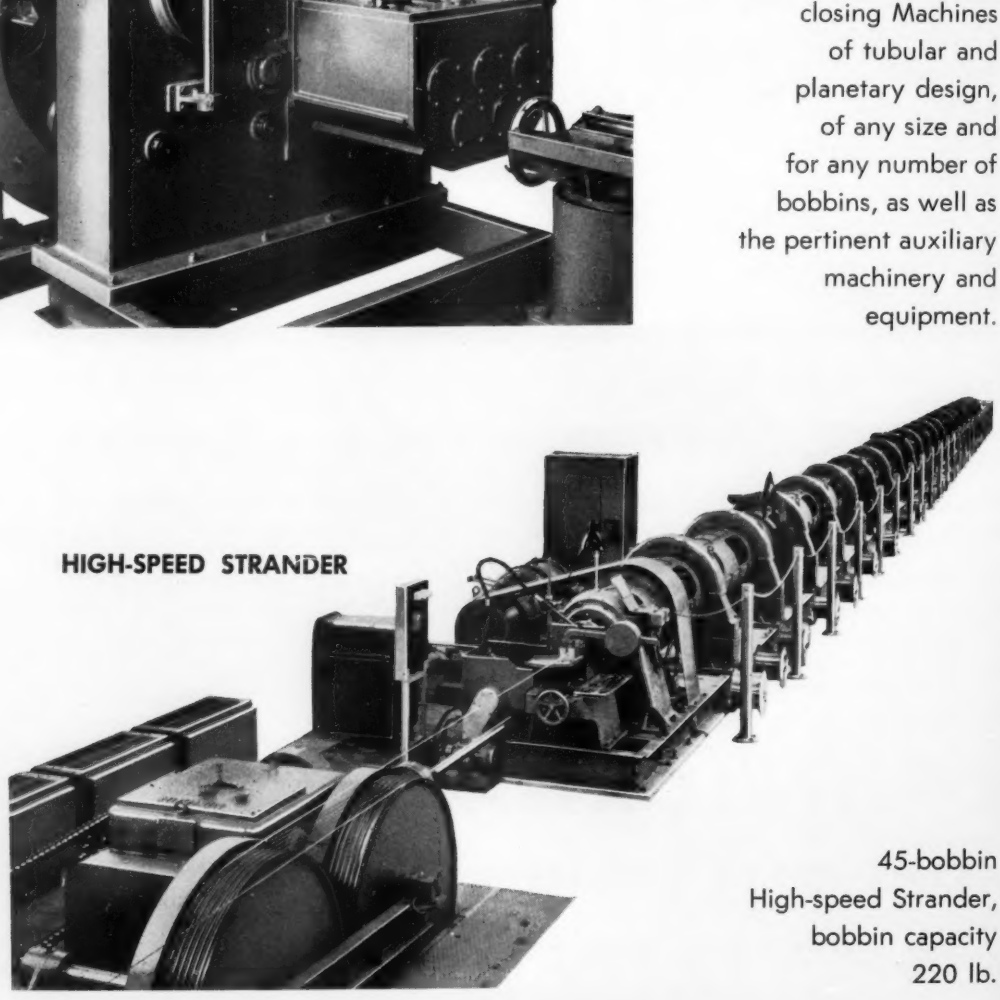
**ELECTRIC-CABLE MACHINERY • WIRE-ROPE MACHINERY**

**PLANETARY STRANDER**



We manufacture: Stranding and Rope-closing Machines of tubular and planetary design, of any size and for any number of bobbins, as well as the pertinent auxiliary machinery and equipment.

**HIGH-SPEED STRANDER**



45-bobbin High-speed Strander, bobbin capacity 220 lb.

**MASCHINENFABRIK K. A. NIEHAUS • DUSSELDORF-RATH**

**Sole Representative: Paul Reicher Machinery & Equipment, 600 Eglinton Ave., East, Toronto 12, Ont., Canada**

# SIMULTANEOUS EXTRUSION OF DIFFERENT COLOR MATERIALS FOR COLOR IDENTIFICATION

**THE PERFECT ANSWER TO 2-COLOR EXTRUSIONS**

for: Striping Identification
Color Coding
Wire Coating
Wire Insulation

Wire manufacturers with a coding problem will find the solution in this new vertical extruder.

This unit is complete and ready for production. It is designed to give you maximum versatility in operation. By means of a height adjustment and rotation of the top part, and by a spin of the barrel, any setup job becomes routine.

The Model 1250 B can be combined, in tandem, with any standard extruder in operations such as adding contrasting stripes to insulation wire.

**MODEL 1250B VERTICAL EXTRUDER**

WE WILL MAKE THE EXTRUDER AND DIES TO MEET YOUR SPECIFIC REQUIREMENTS. LET US KNOW YOUR EXTRUSION PROBLEM. WE WILL SOLVE IT AT NO ADDITIONAL COST.

*Thermoplastic* **Equipment**

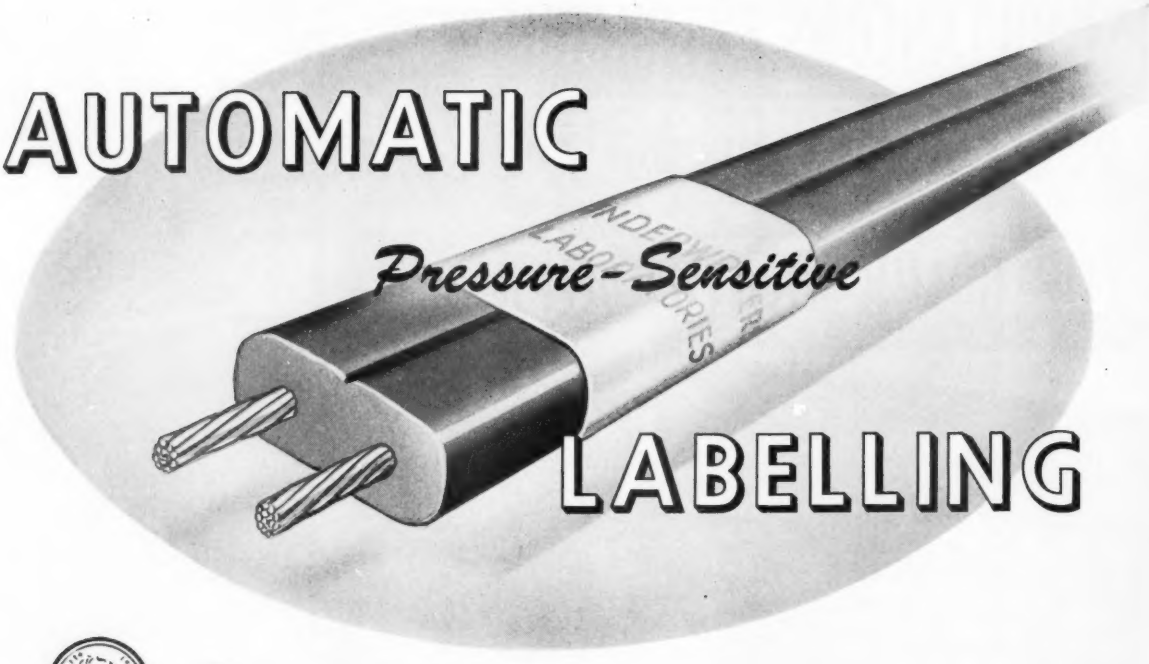
Division of THERMOPLASTIC PROCESSES, INC.

VALLEY ROAD • STIRLING, NEW JERSEY

*Most Experienced 2-Color Extruding Machine Firm In The World*

Millington 7-1003 • Mitchell 3-4600 Nwk. • COrtland 7-6230 N. Y. C.

# AUTOMATIC



*Pressure-Sensitive*

# LABELLING

*Economical*

*Fast*

*Dependable*

Driven by the passage of wire, Entwistle Automatic Labelling Machines perform in conjunction with your reeling, coiling, insulating or cutting and stripping operation requiring little, or no attention after initial set-up.

The Labelling Machine automatically feeds, cuts, applies and securely wraps bracelet or flag type pressure-sensitive labels without injury to insulation.

More than a decade of satisfactory performance proves Entwistle Labelling Machines to be the most practical means of labelling.

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**Manufacturing Corporation**

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*Major*

**BREAKTHROUGH FOR THE WIRE INDUSTRY**

# LOW COST* IRRADIATION

*New*

**DYNAMITRON** "ACCELERATOR FEATURES 10 TIMES MORE PRODUCT THROUGH-PUT . . . SAME CAPITAL INVESTMENT

TYPICAL LOW COST IRRADIATION APPLICATIONS

**FOOD** — for preservation and spoilage reduction

**DRUGS** — "cold sterilization" of antibiotics, surgical supplies and human tissue for transplant

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This entirely new concept in high voltage particle accelerators has broken the radiation "cost barrier." RDI's technological advance features **compactness, reliability, minimum maintenance** and **operating expenses,** and **low capital cost per kilowatt of radiation energy.**

RDI has constructed one of the largest radiation facilities in the country for the purpose of demonstrating practical industrial and military applications.

**Dynamitron models are available from 0.5 Mev. to 3.0 Mev. in power ranges from 7½ Kw. to 30 Kw. For specific information on individual models and processing costs for your industry, write today to Application Engineering, Dept. K.**

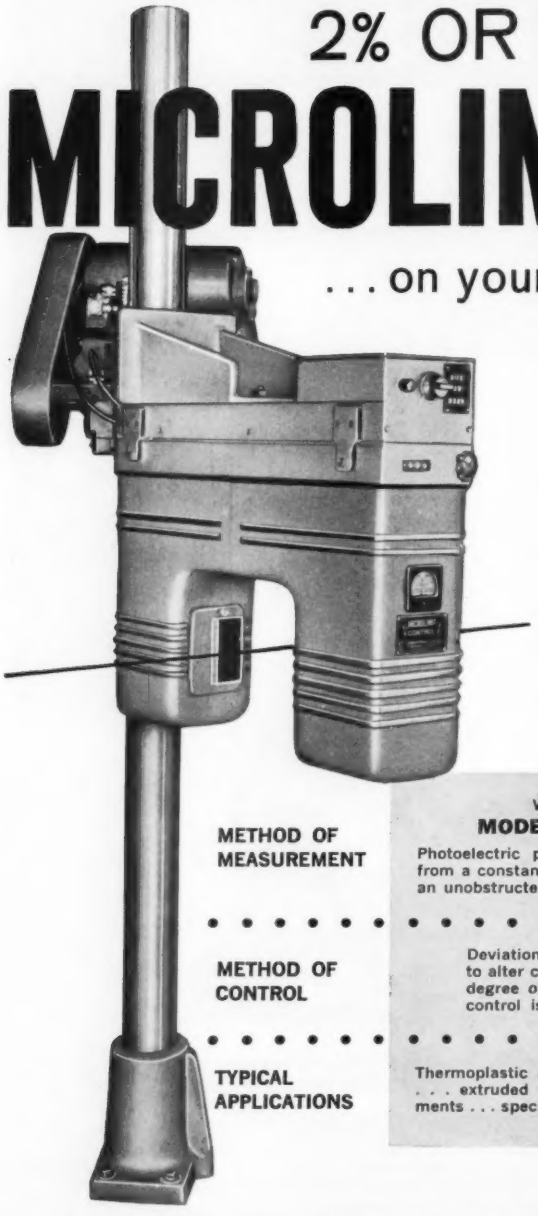
**RADIATION DYNAMICS, INC.**

*Westbury Industrial Park*
*Westbury, Long Island*

*$4,000 PER KILOWATT OUTPUT
**PATENTED

# CUT MATERIAL COSTS 2% OR MORE with MICROLIMIT GAUGES

## ... on your extrusion lines



Control diameter of insulated wire and cable filaments, rod, tubing, shapes—even while still in highly plastic state!

At any speed—even in hot or smoky atmospheres near the die!

Any diameter from .001 to 12.0 inches. Continuous . . . virtually instantaneous . . . non-contact!

**AND SAVE 2%—OR MORE—ON MATERIAL...BY**

- **reducing deviations from your product's nominal diameter.**
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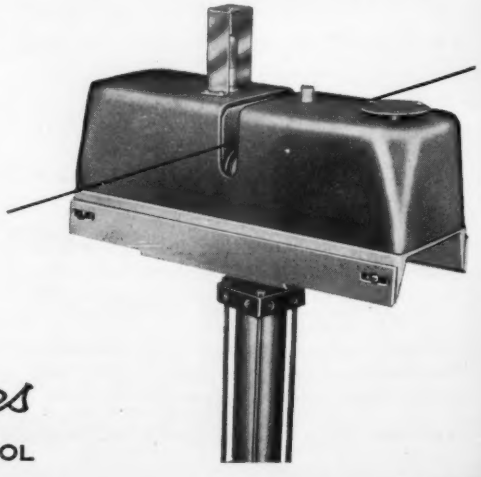
- **cutting start-up wastage in half.**

**REDUCE LABOR COSTS; SPEED PRODUCTION TOO!**

| | WIRE GAUGE **MODELS 5110/309** | CABLE GAUGE **MODELS 5120/310** |
|---|---|---|
| **METHOD OF MEASUREMENT** | Photoelectric pickup of obstructed light from a constant source—balanced against an unobstructed reference beam. | Photoelectric scanning by two light beams moving in tandem. Not affected by clouded atmospheres or deposits on lenses. |
| **METHOD OF CONTROL** | Deviation signals are fed to control console. Its outpu. drives a conversion unit to alter capstan speed or any other production variable. Timing circuits regulate degree of correction . . . permit corrected diameter to register before further control is exercised. Systems are completely integrated to the extrusion line. | |
| **TYPICAL APPLICATIONS** | Thermoplastic and rubber insulated wire . . . extruded tubing, rods, shapes, filaments . . . special wires. | Thermoplastic insulated cable . . . C. V. process and pancured rubber cable . . . extruded tubes, shapes. |

Microlimit Gauges are now sold and serviced by the Daystrom-Weston world-wide organization. For detailed bulletins . . . or other information . . . contact your local Daystrom-Weston representative, or write to Daystrom-Weston Sales Division, Newark 12, N. J. **In Canada:** *Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*



**DAYSTROM WESTON**

*Industrial Gauges*

WORLD LEADERS IN MEASUREMENT AND CONTROL

*Specify*

# BLACAR®

## PVC Resins & Compounds

*New! Recent UL approval of Blacar #2820 for THW. Complete technical information on request.*

**PVC RESIN**—**BLACAR #250**—UL approved for complete interchangeability in recognized compounds. High molecular weight—low gel count—excellent dry blending and extrusion characteristics. Intermediate and low molecular weight resins also available.

**PVC COMPOUNDS**—In natural, white or black-dry blend or diced.

**BLACAR #2800**—UL approved for type T and TW wire—oil at 60°C—80°C appliance wire.

**BLACAR #2700**—UL approved, primary insulation, for type T, TW, TF, TFF wire—oil at 60°C—wide range of low-tension applications.

**BLACAR #2600**—UL approved for type TF and TFF wire and cable insulation.

Specialists in wire covering—Cary has a compound for every UL requirement. Our summary of recommended compounds is available on request.

Technical assistance, complete data, or working samples—available as requested.

CARY CHEMICALS INC.

## CARY CHEMICALS INC.

***Mail address:*** **P.O. BOX 1128, NEW BRUNSWICK, N. J.**

**Plants at: East Brunswick and Flemington, N. J.**

VINYL RESINS — VINYL COPOLYMERS — VINYL COMPOUNDS — SPECIALTY WAXES — HIGH MELTING POINT SYNTHETIC WAXES

**Canadian Representative: Lewis Specialties, Ltd., 18 Westminster North, Montreal 28, Que.**

# WHITACRE 22″ WIRE DRAWING DEAD BLOCK

## Continuous Production—Efficiency Approaching 100%

**Gives you these advantages**

Continuous increased production achieved by: • No down time for stripping • Permits packaging into stationary container or uninterrupted palletizing on stems • No tangling nor snarling from handling • Design simplicity. No back-gearing nor similar mechanisms • Greatly reduced floor space requirements • Dies in supplying drawing machine can be changed without stopping dead block • Accumulation type machines can be "run down" without stopping dead block • Continuous inspection and sampling • Breaks welded in production — low scrap loss • Increased production with lessened operator fatigue • Maintenance eliminated except for occasional lubrication of four main bearings and two motor bearings • Dead block can be located anywhere with wire literally piped from wire drawing machine • Extra large packages for in-process wire • Greatly reduced handling and in-plant transportation costs • Low capital investment.

**OTHER MODELS AVAILABLE**

16" Wire Drawing Dead Block, Model DB-16A • 26" Wire Drawing Dead Block, Model DB-26A • Combination 16" and 22" Galvanizing or Tinning Dead Block Take-ups, Model GB-2216A • 26" Heavy Wire Galvanizing or Tinning Dead Block Take-up, Model GB-26B.

Write Today For Specifications And Name Of Nearest Distributor

**WHITACRE ENGINEERING & MANUFACTURING COMPANY**

5649 ALHAMBRA AVENUE • LOS ANGELES 32, CALIFORNIA • CAPITOL 5-2476

WHITACRE

# *Roebling Wire in convenient bulk packaged to make your products easier*

If you use high-carbon wire in sizes from .060" diam. to .030" diam., it will pay you to investigate Roebling's Reel-less Core Packaging System. This method offers you substantial savings in several ways—to say nothing of the quality wire that Roebling always delivers in any kind of package.

*Here's how simple it is:*
Cores are palletized two cores per pallet and can be stacked two or three pallets high (think of the saving in storage space).

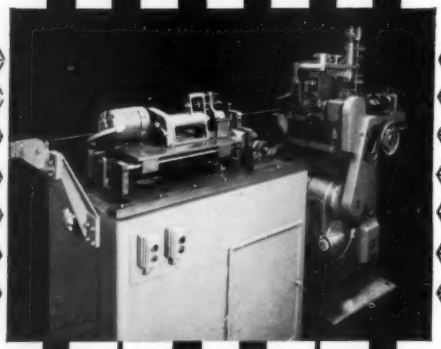
Empty reels are not accumulated because there are no reels to store, send back, bookkeep, get credit on, or pay shipping charges on (either way). Just unwrap the wire, set it up the way you see here, and there you are. Where a limited number of reel-less core packages are used, or where wire is flipped from reels mounted in a horizontal position, the tilt table is not necessary.

This method is typical, indeed, of Roebling's efforts to make quality easier to handle and to banish the problems that cost you time, money and sharp pains across the brow.

Full details of wire without reels will be immediately forthcoming when you write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

**ROEBLING**

*Branch Offices in Principal Cities*
*Subsidiary of The Colorado Fuel and Iron Corporation*



# POOLED ENGINEERING PRODUCES NEW WIRE STRIPPING AND COILING MACHINE

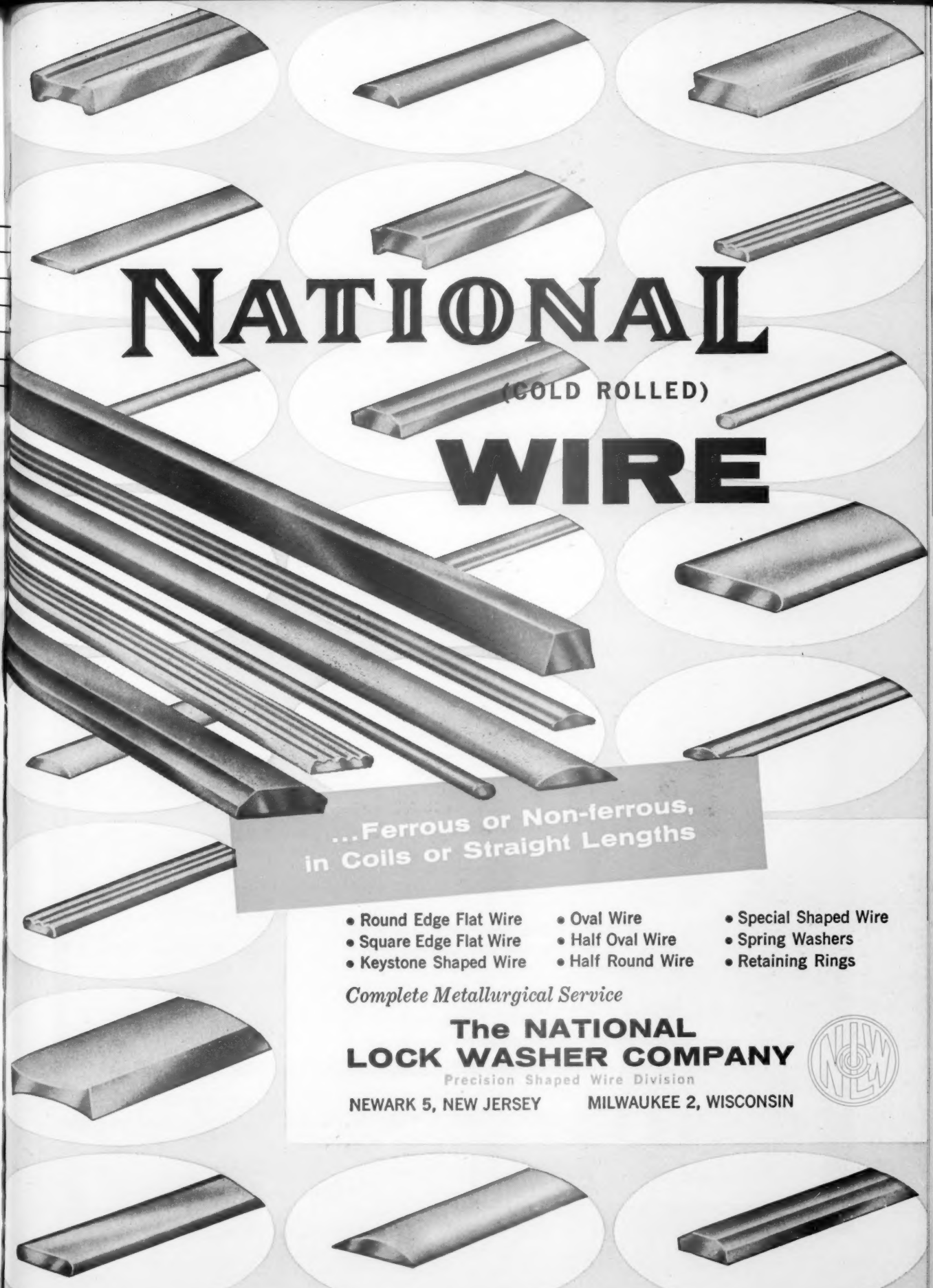
**The Problem** Development of a high speed close tolerance method for producing nylon coated wire circuit breaker coils with pre-stripped ends for soldering. **The Attack** A cooperative program by the Rush Wire Stripper Division of The Eraser Company and Torrington Wire Forming engineers. **The Solution** Combining an intermittent stripper, the new Rush Model 2086 Wire Stripping Machine, and the Torrington W-3000 Torsion Winder. **The Technique** An electric stripping machine is placed between the payoff reel and the Torsion winder. As the winding head begins the recoil stroke, a signal from a cam-operated limit switch on the Torsion winder actuates the stripping mechanism. The machine is timed to strip only that portion of the wire which will appear on the ends of the finished coil. (If a 3/16" strip is needed on each end, the machine strips 3/8" at a time.)

The stripper consists essentially of a stripping head, a clamping device and a traveling table assembly. In the stripping head are mounted four knives which revolve about the wire at high speed and turn down the insulation to the depth desired. The clamping device holds the wire stationary while the table assembly carries the knives back along the wire line. The knives open automatically when the required length of wire has been stripped. The machine follows this sequence of operations: 1. Winding head begins recoil stroke. Wire is stationary. 2. Limit switch sends signal back to stripper. 3. Wire is clamped just forward of the stripping head. 4. Rotating knives bite into insulation. 5. Table assembly moves away from clamp. After required distance knives open. 6. Table assembly returns to original position, ready for next cycle.

Depending upon the length to be stripped, the machine can process upward of 60 circuit breaker coils a minute.

**THE TORRINGTON MANUFACTURING COMPANY**

TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO



# NATIONAL

(COLD ROLLED)

# WIRE

...Ferrous or Non-ferrous,
in Coils or Straight Lengths

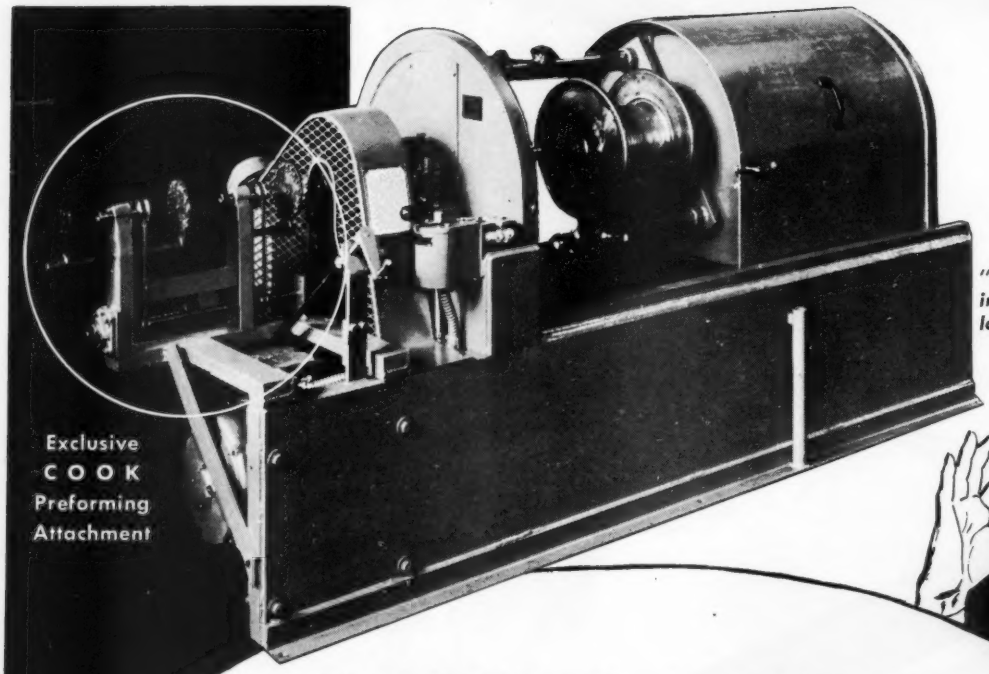
- Round Edge Flat Wire
- Square Edge Flat Wire
- Keystone Shaped Wire
- Oval Wire
- Half Oval Wire
- Half Round Wire
- Special Shaped Wire
- Spring Washers
- Retaining Rings

*Complete Metallurgical Service*

**The NATIONAL LOCK WASHER COMPANY**

Precision Shaped Wire Division

NEWARK 5, NEW JERSEY MILWAUKEE 2, WISCONSIN



Exclusive COOK Preforming Attachment

*"My job is to get maximum production at the lowest possible cost"*

*"I've checked plenty of bunching machines . . . but*

# only COOK bunchers can make perfectly concentric wire!"

*All capacities from 45 lbs. to 1000 lbs. All reel sizes from 8" x 6" up to 30" x 11" based on solid copper wire*

## Now you can speed up production . . . cut the cost of insulating material and labor

The single twist design and large take-up reel are only two of the many outstanding features of COOK bunchers. The single twist principle insures perfectly round bunched wires* at high speed while the **large** take-up reel provides more practical wire packaging sizes for extra long extruder runs. Both these innovations reduce material waste and down time at the extruder.

For production of either concentric wire (with layers of wires in opposite directions of lay) or semi-concentric wire (with layers of wires in the same direction but with different lay to prevent strand locking) you simply can't beat a COOK buncher!

*Bunched wires so perfect that they can pass through an extruding die of only 1 mil clearance

**MEET MILITARY SPECIFICATION: MIL-W-5086**

*Write for free* **BUNCHER** catalog sheet

**COOK** *Manufacturing Co.*

**50 EAST 25th ST., PATERSON, N. J. ★ ARmory 4-6380**

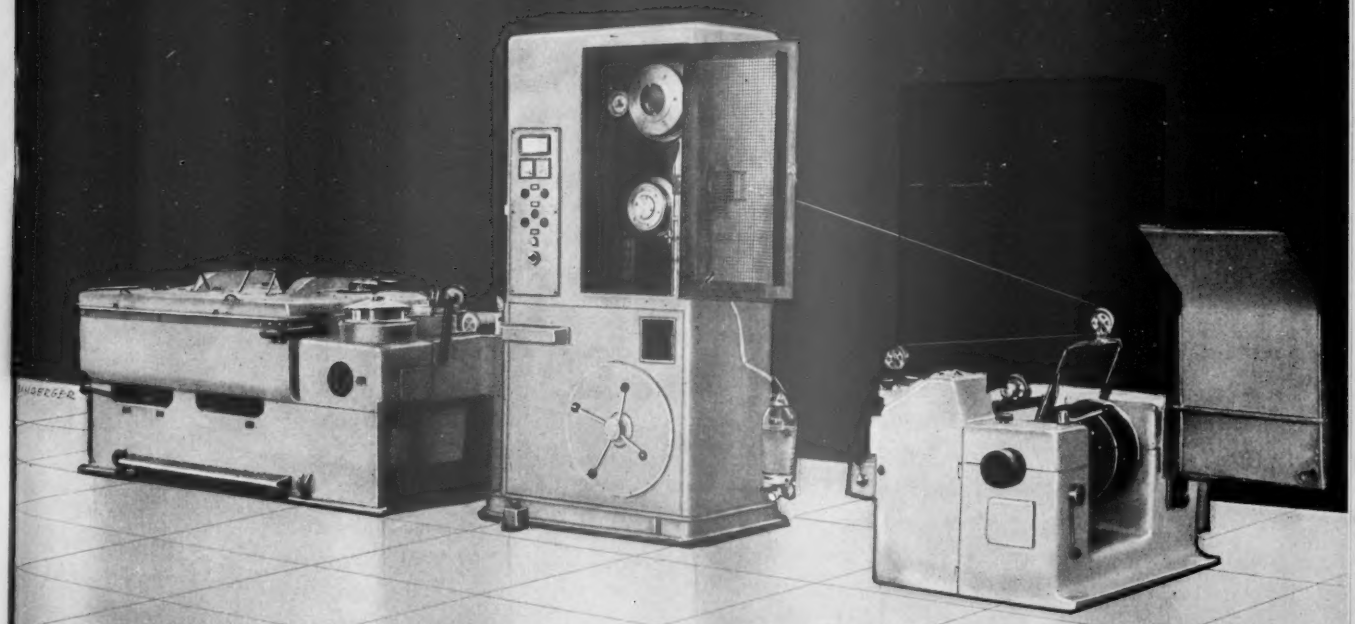
Canadian agent: **E. V. Larson Co., Ltd., Toronto**

European agents: **Capamajian Le Monnier Cie Ltd., Paris**
**Knoerzer & Co., Stuttgart, Germany**

**ASK FOR LITERATURE ON COOK'S HIGH SPEED CABLERS**

AMERICAN LAUBSCHER
Corporation
presents

# NIEHOFF WIRE DRAWING UNITS



EXCLUSIVE REPRESENTATIVE
FOR U.S.A. AND CANADA

AMERICAN LAUBSCHER
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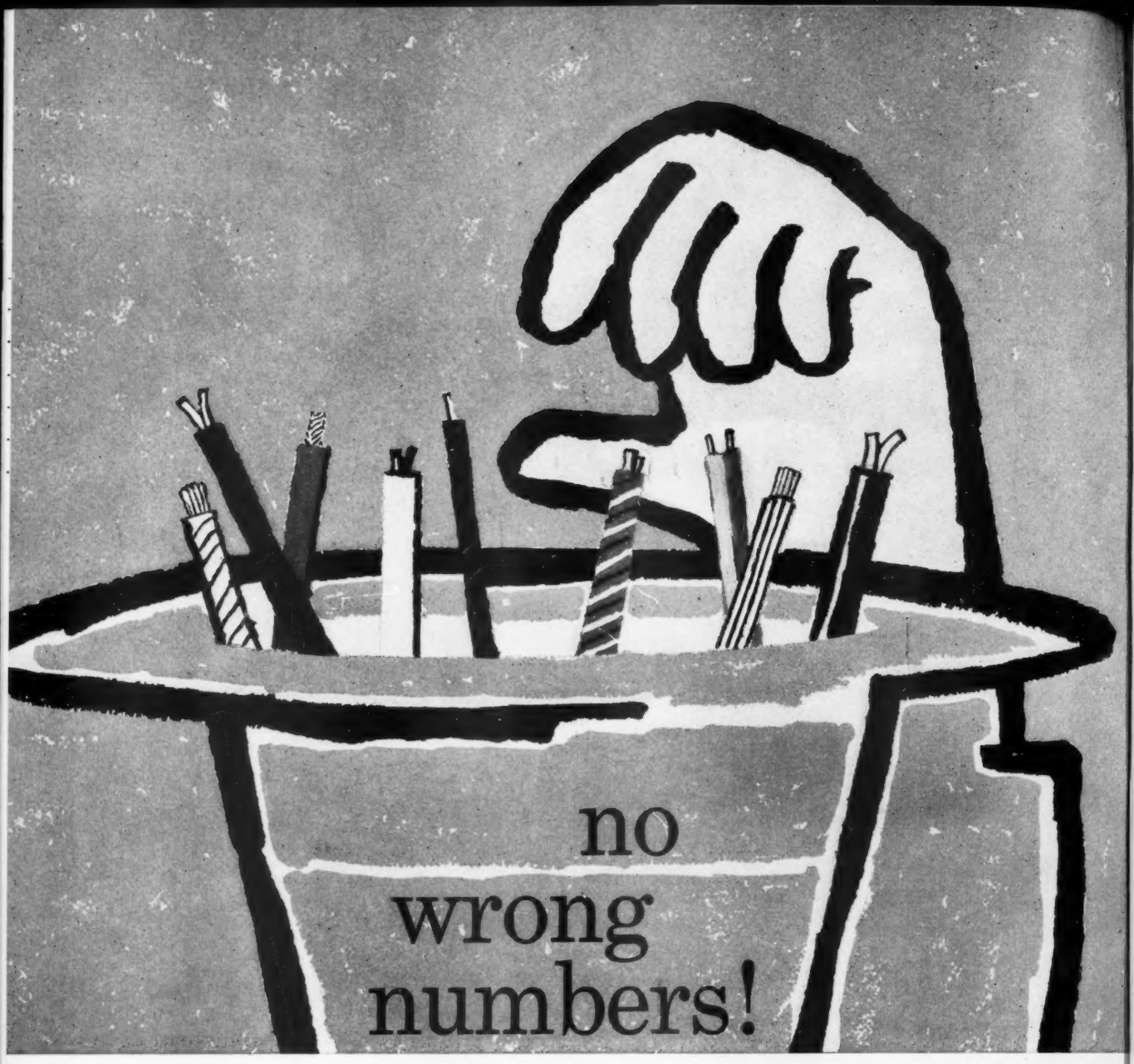
ISK BLDG. 250 WEST 57th STREET
NEW YORK 19, N.Y.

## NIEHOFF MACHINE WORKS

SCHWABACH NEAR NURNBERG WESTERN GERMANY




MONSANTO POLYETHYLENE formulations are based on long experience in supplying the specialized needs of the Wire and Cable Industry. That's why you can always count on a correct answer to your specific insulation problem, when you call Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.

*OPALON: REG. U.S. PAT. OFF.

Monsanto

**MPE 10** medium molecular weight natural, with non-discoloring antioxidant; primary insulation for telephone cable, power cable, control cable, and general insulation use.

**11302** medium molecular weight black, with non-discoloring antioxidant; for line and drop wire insulation, weather-resistant primary and support wire insulation, general purpose jacketing.

**12203** high molecular weight natural, with non-discoloring antioxidant; primary insulation for telephone, power, and control cable; insulation requiring superior toughness, maximum stress crack resistance.

**12253** medium molecular weight natural, with non-discoloring antioxidant; for primary insulation for coaxial cable, power cable, telephone cable, and general insulation use.

**14202** high molecular weight black, with non-discoloring antioxidant; telephone and power cable jacketing; all jacketing and insulating applications requiring maximum stress crack and weather resistance.

Monsanto has also developed a complete line of Opalon* Vinyl compounds for wire and cable insulation.

*Are you receiving your monthly "WIRE RECORDER"? Use coupon to get this useful news bulletin published by Monsanto.*

Monsanto Chemical Company,
Plastics Division,
Springfield 2, Mass.

Please place my name on your mailing list to receive free monthly copy of "WIRE RECORDER"

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

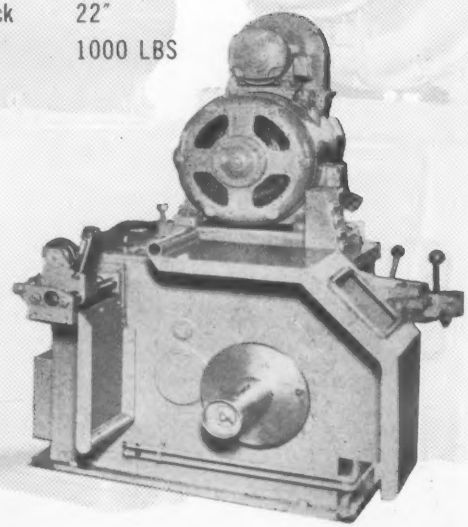
DEC

# ROD BREAKDOWN MACHINE

**Specification**

| | |
|---|---|
| Entry size | 3/8", 5/16" Soft copper rod. |
| Finished size | No. 6 to No. 14 B & S(4.0m/m 1.6m/m) |
| Finishing speed | 1500 to 4000 F.P.M. 6 change. |
| Number of dies | 11 |
| Diameter of capstan | 14" 6-tandem |
| | 18"/11.6" 2-cone tandem |
| Motor size | 250 HP |
| Diameter of coiler block | 22" |
| Max. Spool capacity | 1000 LBS |

MODEL AH-11

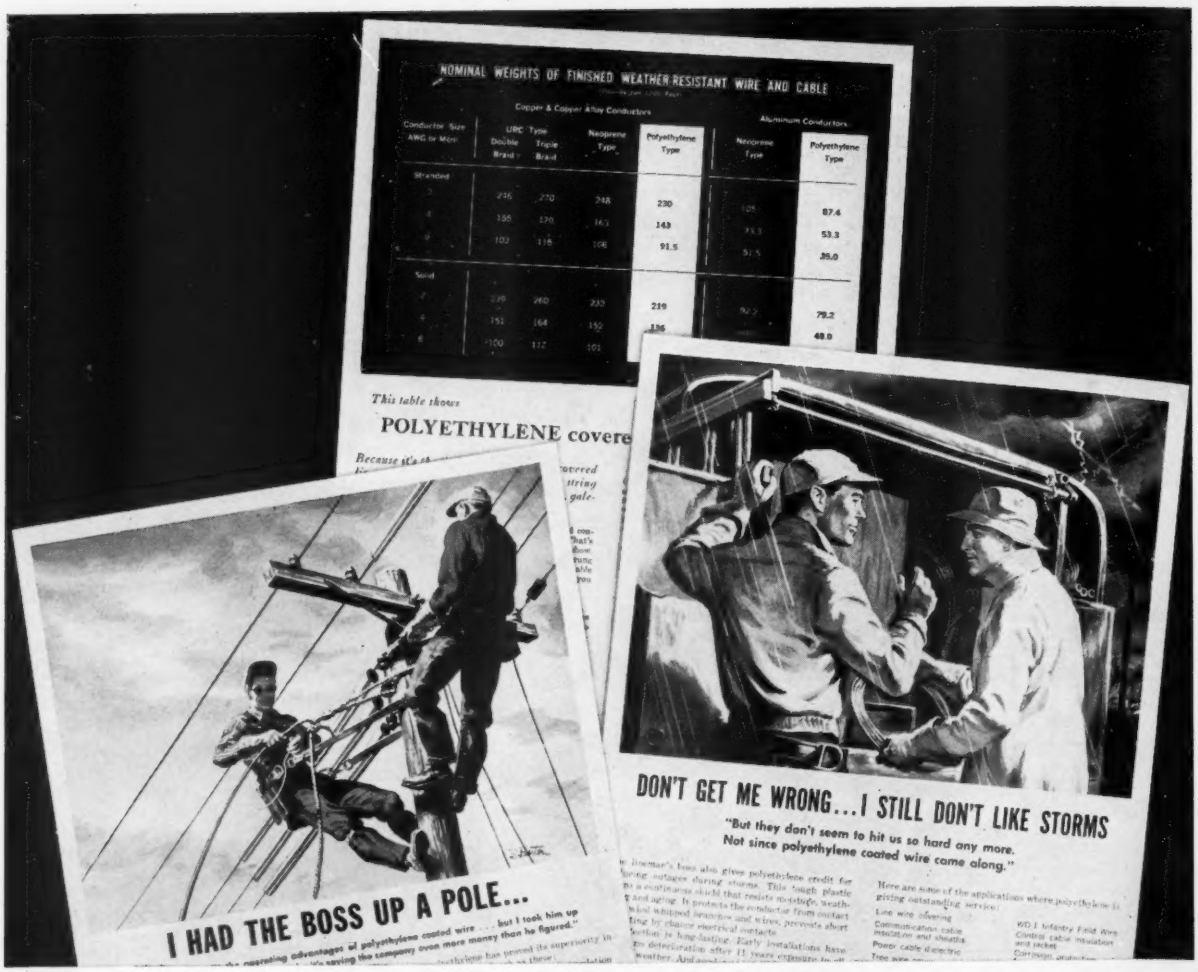


**4000 FPM at BS #12**

**SHOWA MACHINE WORKS LTD.**

No. 16, Naka 3-chome, Mitezima, Nishi-Yodogawaku, OSAKA, JAPAN. Tel. (47) 3051

SHOWA


NOMINAL WEIGHTS OF FINISHED WEATHER-RESISTANT WIRE AND CABLE
Copper & Copper Alloy Conductors
Aluminum Conductors
Conductor Size AWG or Mcm
LIRC Type Double Braid
LIRC Type Triple Braid
Neoprene Type
Polyethylene Type
Neoprene Type
Polyethylene Type
Stranded
Solid
This table shows
POLYETHYLENE covere
I HAD THE BOSS UP A POLE...
DON'T GET ME WRONG...I STILL DON'T LIKE STORMS
"But they don't seem to hit us so hard any more.
Not since polyethylene coated wire came along."

# TELLING THE POLYETHYLENE WIRE STORY CAN BUILD FUTURE PROFITS FOR YOU

Polyethylene-covered line wire has many advantages for users: Exceptional weather and stress-crack resistance. Easy handling and installation. Long life in service. Fewer outages and minimum maintenance.

We've been telling your customers the polyethylene story in utility magazines through advertisements like those above. And more and more users are specifying polyethylene covering for line wire and many other applications. Why not join us in this effort?

**Polyethylene can make your operations simpler, with a more profitable future too.**

- The resin comes ready-to-use — nothing to add, no blending, no milling, no post-extrusion vulcanizing. With production based completely on polyethylene, one line replaces several, providing savings in equipment, floor space, maintenance and labor. And there's only one material to purchase and inventory.
- Unlike costs of other insulating materials, which are trending upward, polyethylene price history promises long-term stability. This means polyethylene can be expected to be your most profitable line wire coating in the years ahead.

**You can build a solid base for future sales and increased profits by promoting polyethylene line wire now among your customers and prospects.**

As you make recommendations, you will find our new data sheet, "PETROTHENE® Resins for Wire and Cable Industry", helpful in selecting resins with the proper balance of properties for different applications. Also available is U.S.I.'s comprehensive 100-page "PETROTHENE Polyethylene . . . A Processing Guide." Write for your copies.

**U.S. Industrial Chemicals Co.**
**Division of National Distillers and Chemical Corp.**
**99 Park Ave., New York 16, N. Y.**

**Please send me:**

☐ "PETROTHENE Resins for the Wire and Cable Industry"
☐ "PETROTHENE Polyethylene . . . A Processing Guide"

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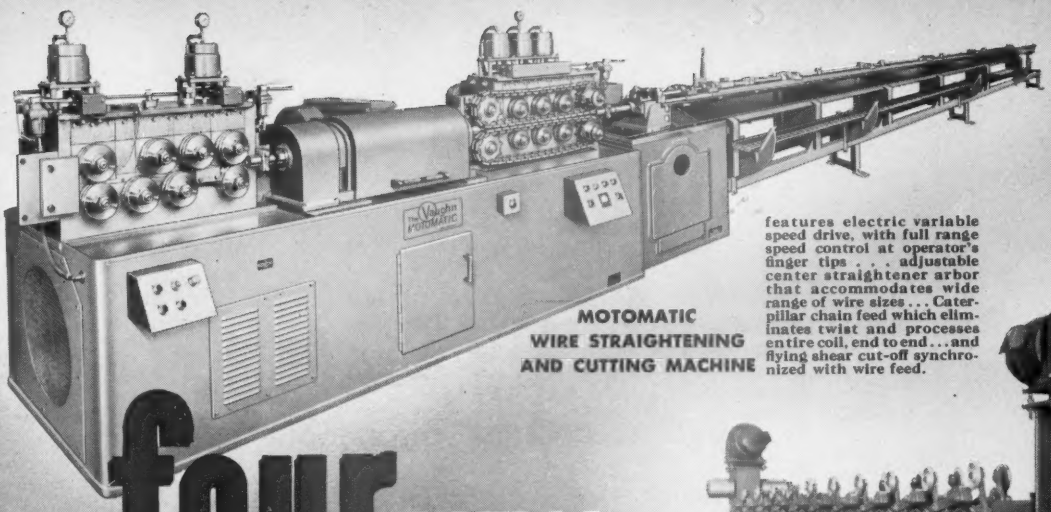
**U.S.I. INDUSTRIAL CHEMICALS CO.**
**Division of National Distillers and Chemical Corp.**
**99 Park Ave., New York 16, N. Y.**
***Branches in principal cities***



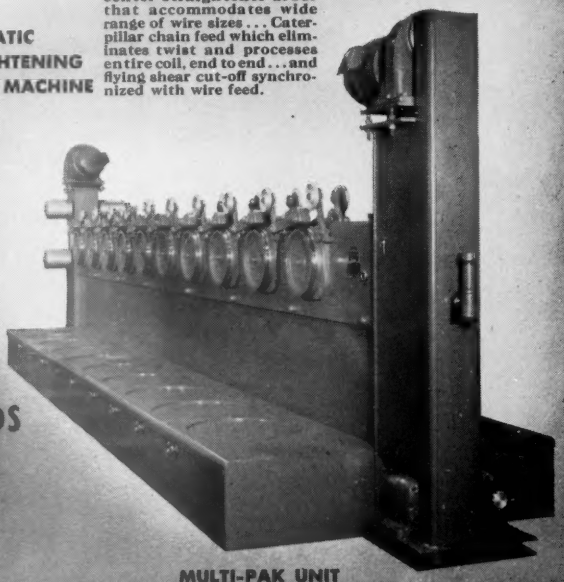
**MOTOMATIC WIRE STRAIGHTENING AND CUTTING MACHINE**

features electric variable speed drive, with full range speed control at operator's finger tips . . . adjustable center straightener arbor that accommodates wide range of wire sizes . . . Caterpillar chain feed which eliminates twist and processes entire coil, end to end . . . and flying shear cut-off synchronized with wire feed.

# four NEW VAUGHN PRODUCTS

## TO MEET THE WIRE INDUSTRY'S DEMANDS

- *for high speed, heavyweight coils . . .*
- *for wire laid in pay-off packs . . .*
- *for straight, precision-cut length wire . . .*



**MULTI-PAK UNIT (20 strand)**

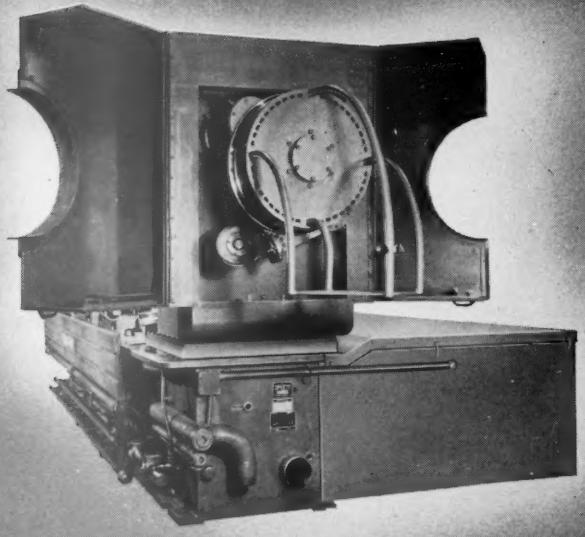
for faster, more efficient laying of wire in pay-off packs, drums or pails

MODERN Vaughn EQUIPMENT

**STATIONARY BLOCKS**

for drawing and/or coiling to provide heavy weight compact coils. Available in either horizontal or inverted vertical designs.
16½ Gauge Galvanized Low Carbon Wire • Coil Weight—1611# Coil I.D.—14" • Coil O.D.—29" Coil Height—29"

Large Size Wire Bundle made on Stationary Block



**STATIONARY DRAWING BLOCK CONVERSION UNIT**

which can be substituted for conventional finishing block on existing MOTOBLOX, to provide continuous drawing of heavy weight coils at high speed.

## The VAUGHN MACHINERY COMPANY

CUYAHOGA FALLS, OHIO

COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

# 3 *Reasons*

why

# HERBORN Wire Drawing Machines

have found acceptance throughout the entire world

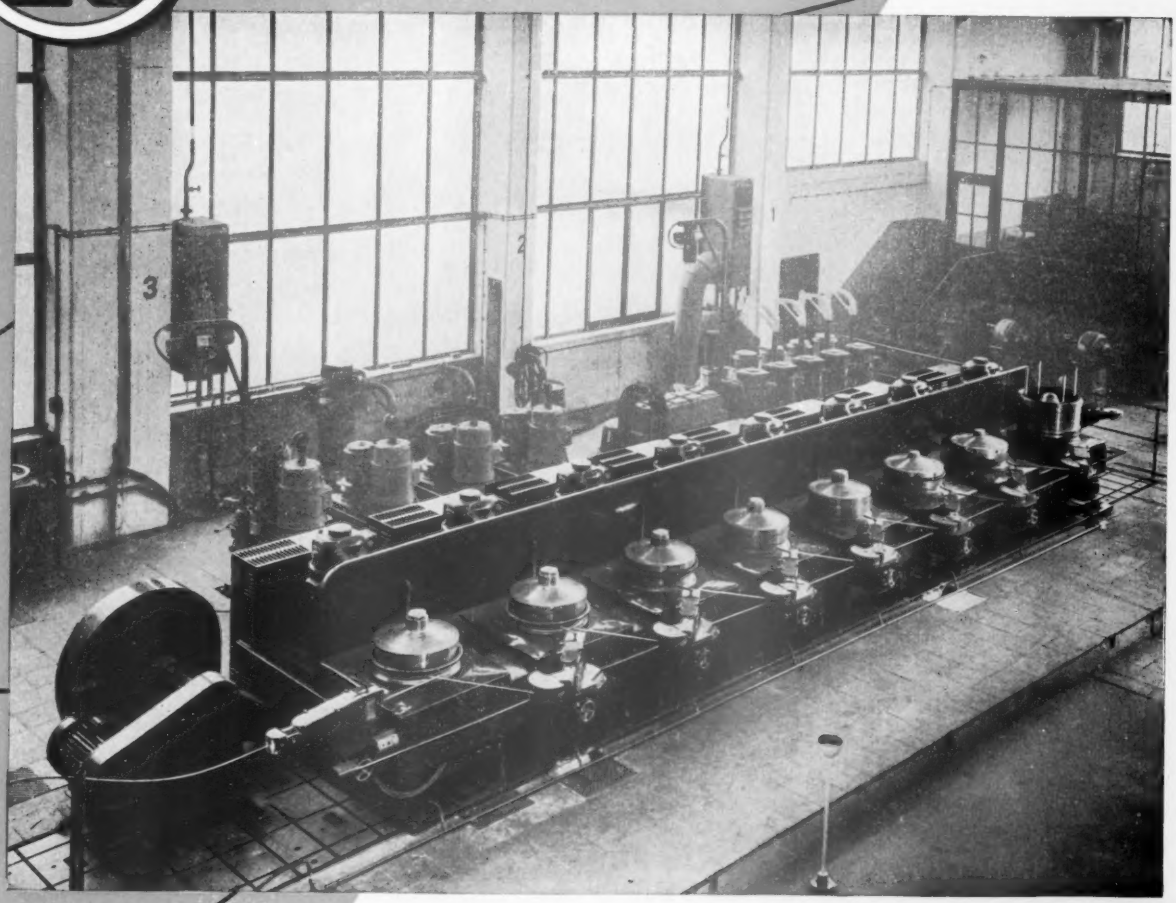
**(1) modern assembly plants and equipment guarantee prime quality and workmanship.**

**(2) operating experience for our machines is provided by our own wire mills.**

**(3) our comprehensive fabrication program can fill all requirements of the wire drawing industry.**

**Our Plant**

# HERBORN



**HERBORN straight-through wire drawing machine model G Ia with 3 to 8 drafts,**

**alternating current drive, with air- and water cooling system, for the drawing of medium and high carbon spring wire with starting size from 3/8" diameter, as well as non-ferrous wires of suitable diameters.**

**Please send us your inquiries, we shall be glad to submit suggestions and proposals**

**MASCHINENFABRIK HERBORN**
BERKENHOFF & DREBES A. G., HERBORN/GERMANY

**HERBORN MACHINERY CORPORATION**
**61 Hudson Street**
**Hackensack, N. J.**

# SHUSTER® 1AVS Automatic

## Wire Straightening and Cutting Machine variable speed - electrically controlled

**The Production Booster with infinite variable speed control and The New Electro Mechanical Positive Release Target**

**CAPACITIES 1AVS—5**

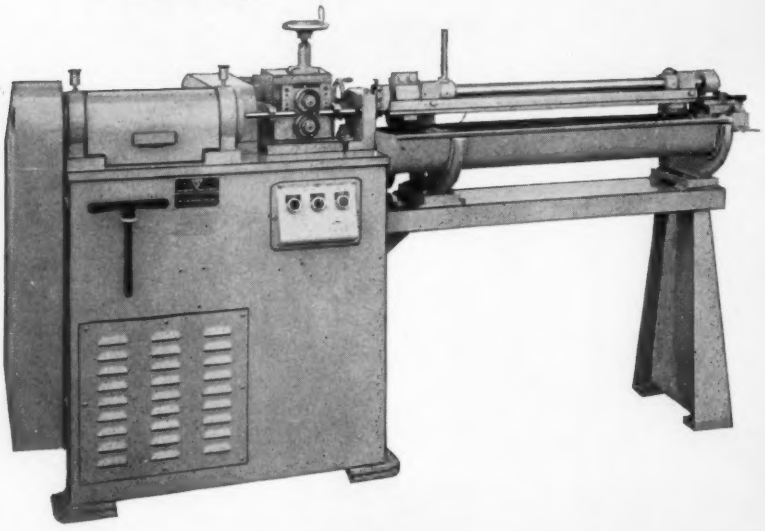
**.062" to .250" basic wire**
**.062" to .148" spring wire**
**50 to 200 F.P.M.**

**CAPACITIES 1AVS—3**

**.062 to .187" basic wire**
**.062 to .125" spring wire**
**50 to 200 F.P.M.**

Production:
Lengths up to 13"
144 pieces per minute

TIMKEN Tapered Roller BEARING EQUIPPED



## The BEST is *STANDARD* with SHUSTER!

Illustrated is the new 1AVS SHUSTER AUTOMATIC WIRE STRAIGHTENING and CUT-OFF MACHINE. Many new features are included as Standard Equipment on these High Speed 1/4" and 3/16" capacity machines.

Features include: High Speed Straightening Arbor with elongated split dies for proper bearing surface and optimum straightening speed, new Shuster Electro-mechanical positive release target, with electrically controlled tripping mechanism to instantaneously operate roll type clutch. Feed roll housing and fly wheel are Timken bearing equipped. All mechanisms are mounted on Shuster Welded Steel Base. Also included are new improved Guide Bar, Guide Bar Cover and a new Angled Control Panel together with properly engineered working height.

There are more SHUSTERS in use throughout the world than all other machines of its type.

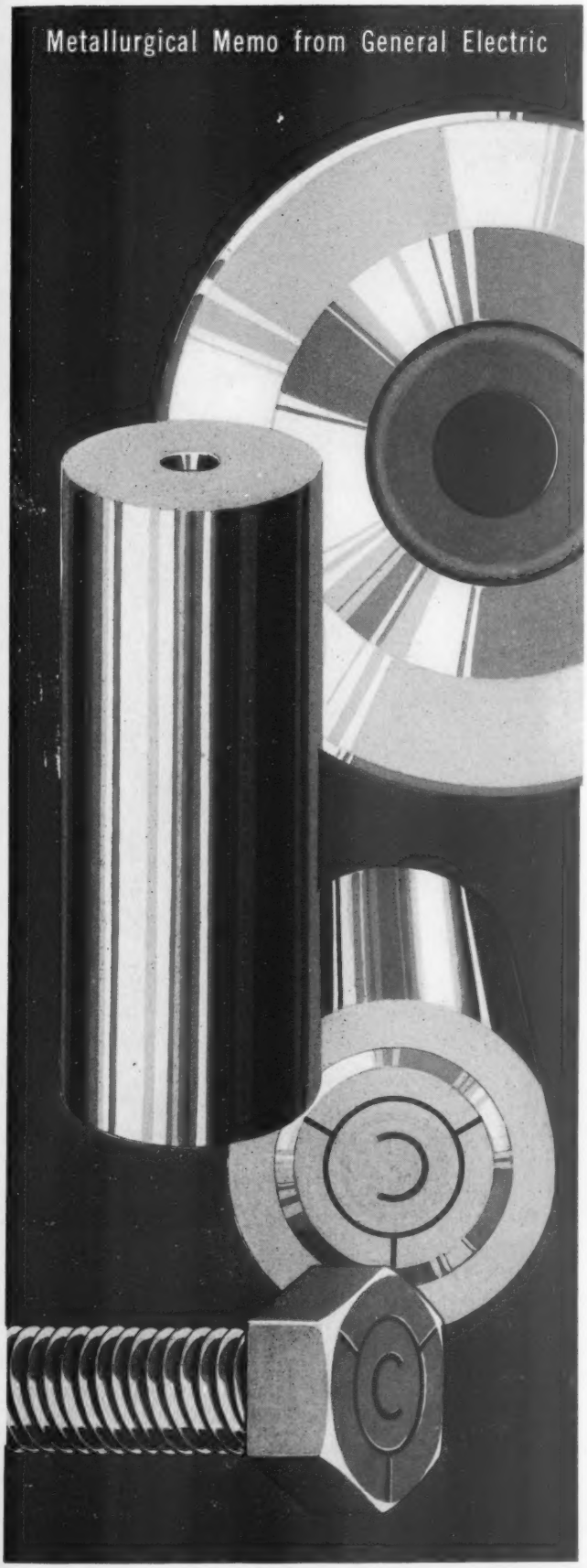
**SHUSTER**

**Wire Straightening and Cut-off Machines and Components are built in 49 models from .020" to 11/16" Mettler Machine Tool also manufactures the SHUSTER 5/16" capacity. Thread Rolling Machines**

*Send us your wire straightening requirements from .020" to 11/16" for quotation.*
*Let us prove to you that a SHUSTER pays for itself faster than any other comparable machine.*

# METTLER MACHINE TOOL, INC.

155 West Adeline Street, New Haven, Conn.




# How Carboloy® dies play a part in your profits

Metallurgical Products Department reports on developments that cut wire die costs . . . and on why they are more important today than ever

New applications, techniques, and materials developed in the wire industry demand cemented carbides in dies that can keep pace. And Carboloy wire dies are designed to bring you the advantages of top quality *and* economy!

Carboloy dies—for drawing, extruding, heading, and flattening—reduce costs in several ways. Designed to last longer and turn out pieces of uniform high quality, Carboloy wire dies result in continuous production, minimum reconditioning, less downtime, fewer rejects. Carboloy dies are held to close tolerances to give your products a better finish with less buffing and polishing . . . coupled with absolute conformity to specifications.

These economies—more tonnage per die, improved products, minimum downtime, fewer rejects—combined with low initial cost, make Carboloy wire dies a wise choice when you're looking for reduced expenses AND HIGHER PROFITS!

Why not look into what Carboloy dies offer—there's one to fit your exact need. For further information—or for technical assistance as it relates to your operation—write: *Metallurgical Products Department of General Electric Company*, 11171 *E.* 8 *Mile Street, Detroit* 32, *Michigan.*

**CARBOLOY®**
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT
**GENERAL ELECTRIC**

CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • VACUUM-MELTED ALLOYS
THERMISTORS • MAGNETIC MATERIALS • THYRITE®

# A delicate problem . . .

**SCHLATTER**

For over 40 years we have been specializing in all kinds of welding problems. New solutions are constantly being found in close co-operation with our customers all over the world. Our great experience may also assist you in solving a particularly delicate problem. Especially for the wire industry, machines and complete installations have been built – from the smallest wire butt welder to the largest wire mesh welding plant – unique in their technical conception and performance-tested in everyday use.
Therefore, do not look for the "Egg of Columbus" – let our engineers and technicians study your problems.

Representative for Canada and USA
**PAUL REICHER Machinery and Equipment, Ltd.**
**600 Eglinton Ave., East,**
**Toronto 12, Ont., Canada**

**H. A. SCHLATTER LTD. ZOLLIKON-ZURICH (SWITZERLAND)**
ELECTRIC WELDING MACHINES AND ELECTRONIC CONTROLS

**NAUGATUCK Naugapol** specially-processed SBR polymers

# DRY...like the Dust Bowl!

The Southwest's Dust Bowl at its driest is no more lacking in moisture than is rubber insulation or rubber products made from Naugapol® polymers. That's because all eight types* of these styrene-butadiene polymers are *specially-processed* for low moisture absorption.

Water-absorbing salt, generally used as a coagulant following polymerization, is eliminated in the manufacture of Naugapols. Extra straining and milling further remove all water-solubles from the dried polymers, yielding easy-processing rubbers noted for their:

- HIGH DIELECTRIC PROPERTIES
- LOW MOISTURE ABSORPTION
- LOW ASH CONTENT

These are the qualities that make Naugapol polymers so strongly preferred by manufacturers of rubber-insulated wire and cable, mechanical rubber goods and other rubber products requiring high electrical insulating qualities and excellent mechanical characteristics over a wide temperature range.

*Naugapols are made in types 1016, 1018, 1019, 1021, 1022, 1023, 1503 and 1504.

**Naugatuck Chemical**

Division of United States Rubber Company 1229 N. Elm Street Naugatuck, Connecticut

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U. S. Office: **WAFIOS MACHINERY CORPORATION, 61 Hudson Street, Hackensack, New Jersey**
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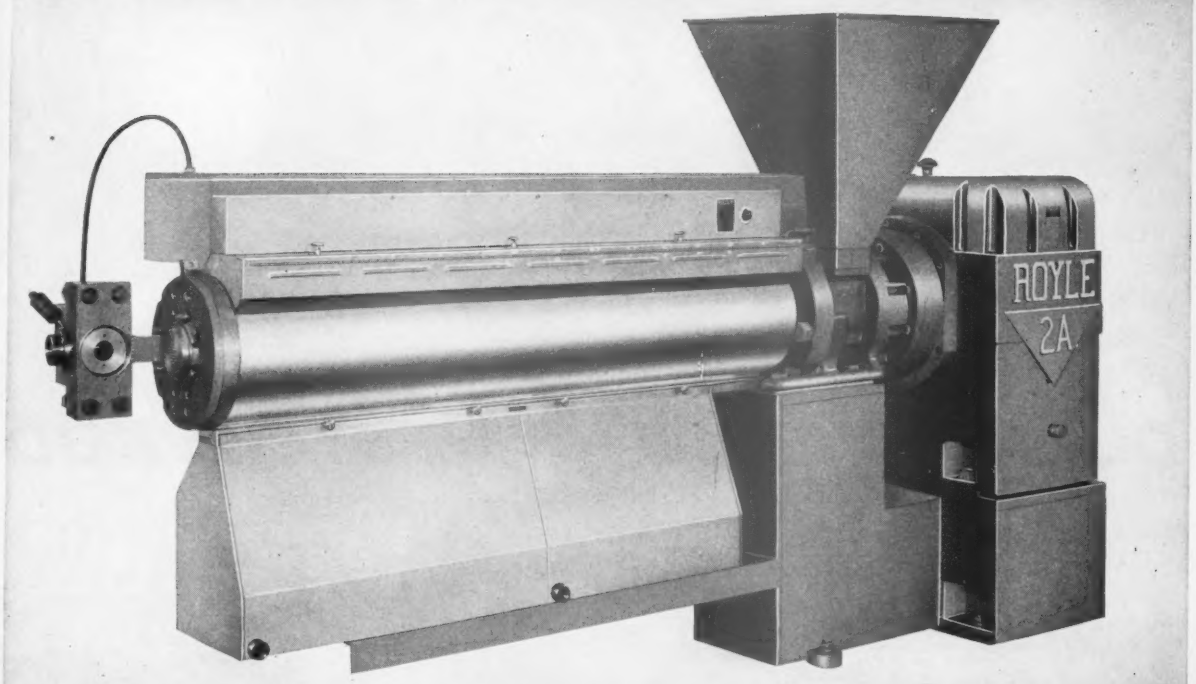
*Royle brings you*

# FASTER PRODUCTION WITH LESS WASTE




Royle Spiron Extruders are expressly designed for high speed vinyl operations. At the same time, they assure you quality controlled production and lower overhead.

The engineering advances that bring you these benefits are especially suited to the high-output, high sock screw speeds, due to longer length to diameter ratios and extremely efficient evaporative cooling.

Longer L/D screws provide greater plasticizing ability, while evaporative cooling at each feed roller on the cylinder removes the excess frictional heat generally encountered with high sock screw speeds.

*As they have been since 1880,*
*Royle is first in Extruder development.*

ROYLE

JOHN ROYLE & SONS

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*Please, send me full information about Royle High Speed Vinyl Extruders.*

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Company_____

Street_____

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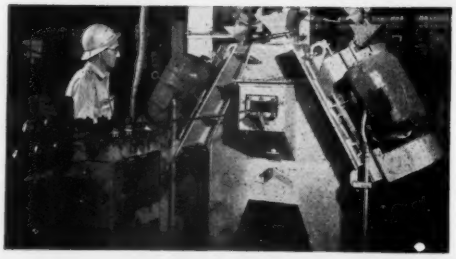
# DUNKING IS NOT FOR STEEL ROD

## *Wheelabrator® abrasive blast descaling automates wire drawing and processing lines*

Through application of Wheelabrator blast descaling, it is now possible to clean, coat, draw, and cold head in one continuous operation and secure the following advantages:

* **Strand cleaning and coating ahead of cold drawing**
* **Faster, more uniform cleaning**
* **Superior finish for coating and die lubrication**
* **Elimination of multiple handling of hot rolled coils**



These cost-cutting Wheelabrator advantages are already being obtained by prominent producers of wire products in descaling various size rod at speeds up to 600 f.p.m. New applications in the wire products field are constantly being developed. It will pay you to investigate the Wheelabrator for your cleaning problems. Write today for complete information.

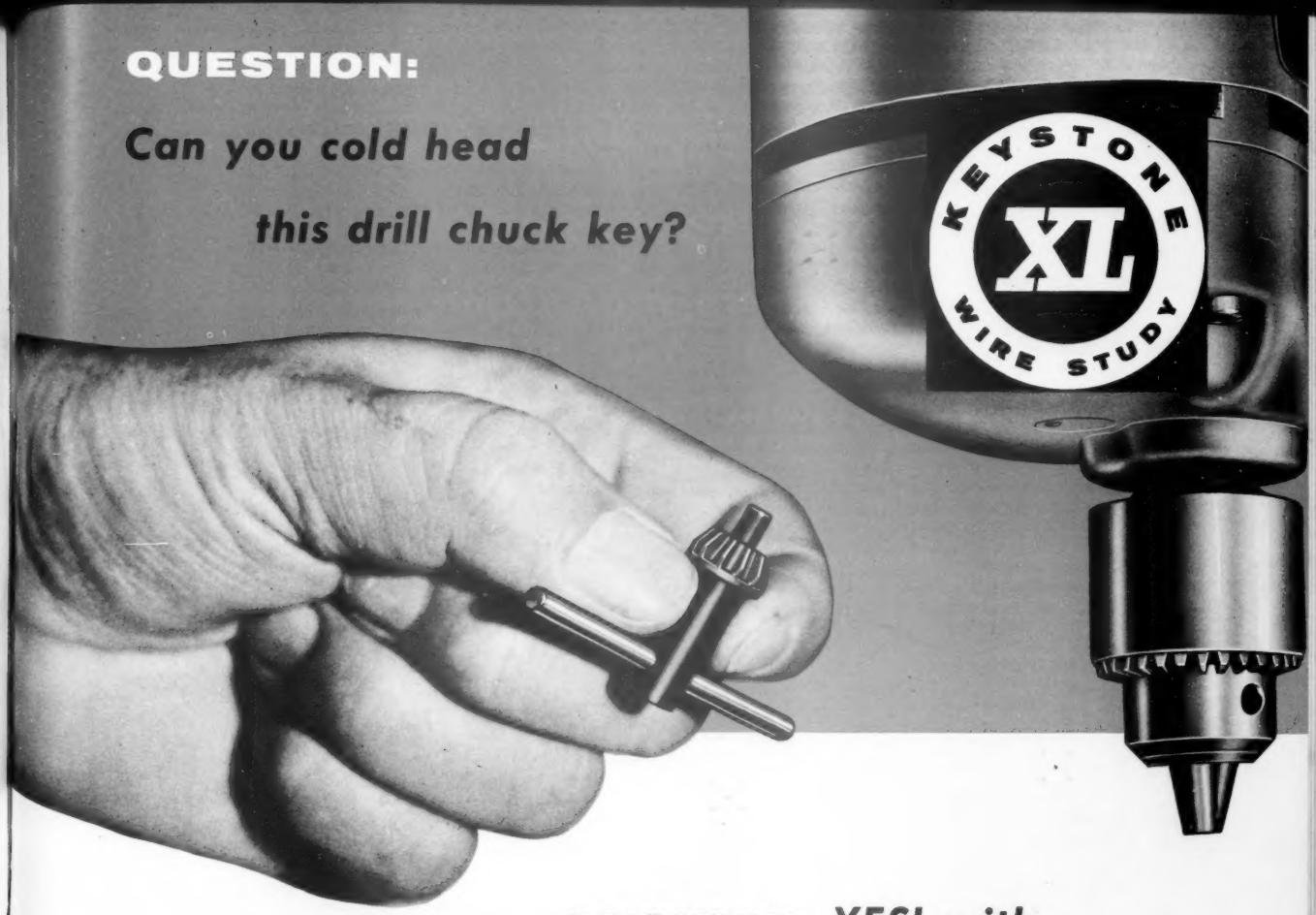
***Send for Bulletin No. 148-D***

**WHEELABRATOR**
CORPORATION

**389 South Byrkit Street, Mishawaka, Indiana**
Canadian Offices: Scarborough (Toronto) — Montreal

**QUESTION:**

## *Can you cold head this drill chuck key?*




**ANSWER:** ***YES! with***

## CENTRAL SCREW COMPANY *engineering and KEYSTONE XL WIRE*

Questions like this are asked every day at Central Screw Co., Chicago, Ill.—and this is a typical answer! For Central Screw depends on Keystone XL Wire to head more than 7,500 stock items by the millions—and for many of its 20,000 specials. Here, as with many other progressive fastener manufacturers across the country—"know-how" combines with Keystone XL Wire quality and flowability to produce a superior product at sharply reduced costs.

For example, by cold heading this drill chuck key, gear cutting was eliminated and machining was reduced. Overall costs were cut about 50%. This is one of *millions* of examples of how Central's "Fasteneering"® profitably puts Keystone XL Wire to use. You can do the same. Your Keystone representative will help you. Call him!

*Keystone Steel & Wire Company, Peoria 7, Illinois*

Five operations now produce this chuck key: heading on a 2 blow header, cut pointing, drilling, chamfering and heat treating.

ACTUAL SIZE

More Central Screw examples of Keystone XL Wire flowability are (above) this fastener with an 8 diameter thin shell head, and (right) fastener with 6½ diameters in the sharp, clean head and square shoulder.

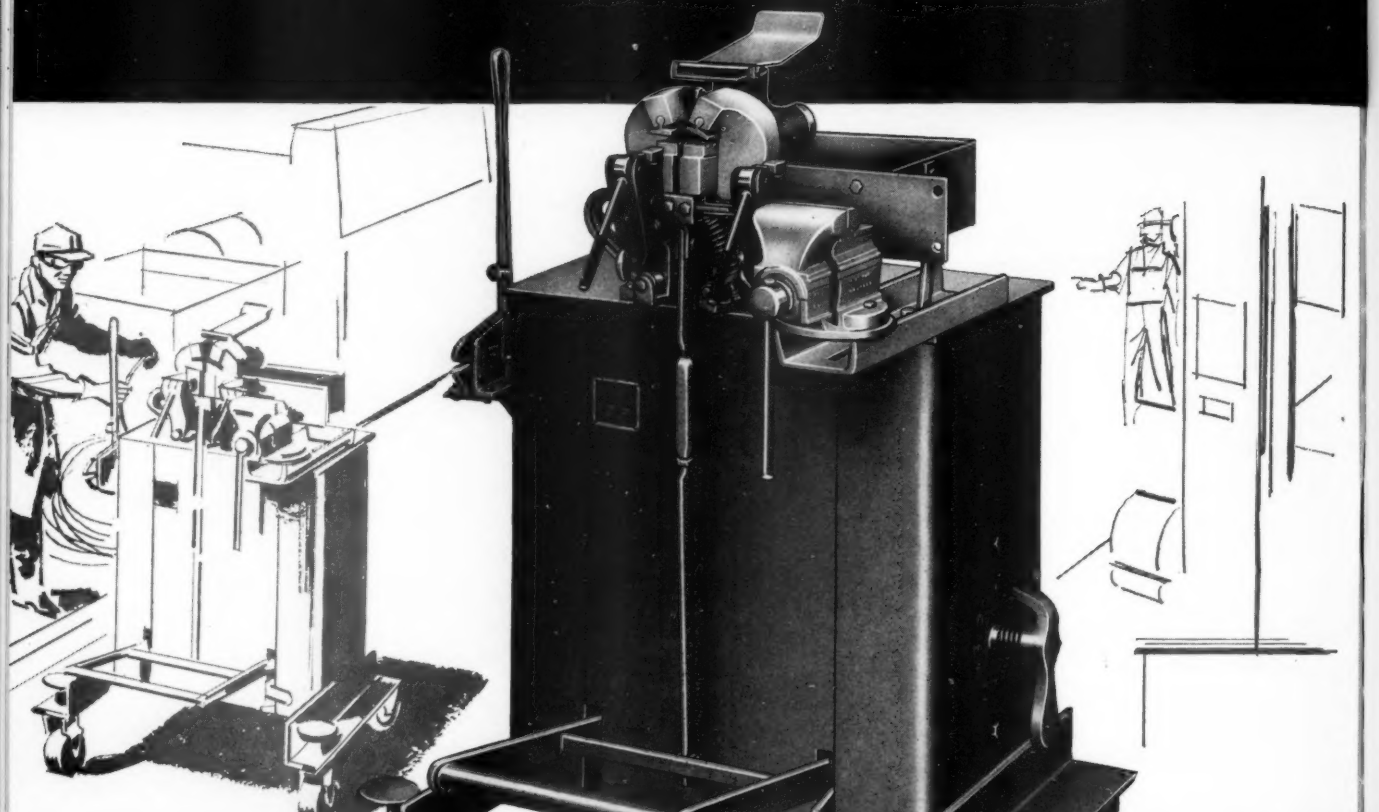
**KEYSTONE**

WIRE FOR INDUSTRY

# FIRST..... in the field

# FASTEST..... automatic single stroke action

# FOREMOST..... with manufacturers who demand quality, simplicity and ease of operation



## MODEL "J" TYPE AUTOMATIC MICROWELD BUTT WELDER FOR NON-FERROUS WIRE AND ROD

The welding cycle on these units is automatically completed by one single downward stroke of the foot pedal, which clamps the stock being welded, contacts the welding switch, and applies the spring upset pressure on the weld.

All welders are equipped with annealing dies, filing vise, hand shears, and mounted on 4-wheel truck.

Available in four Models —

| | |
|---|---|
| **MODEL J-45-C** .080" to .204" Dia. | **MODEL J-5-C** .128" to .257" Dia. |
| **MODEL J-7-C** .187" to .375" Dia. | **MODEL J-8-C** .250" to .500" Dia. |

for welding Copper, Copper Alloys and E. C. Aluminum wire in sizes from .080" to .500" diameter.

MICROMETER PRECISION MICRO-WELD ®

## MICRO PRODUCTS CO.

20 NO. WACKER DRIVE • CHICAGO 6, ILLINOIS • TELEPHONE STate 2-7468

# 500 Feet Per Minute!

## With a Lewis Wire Straightening and Cutting Machine

**No. 4FH "Travel-Cut", Automatic Flying-Shear Wire Straightening and Cutting Machine designed for high-speed cutting. Capacity in mild steel, 3/32" to 1/4" . . . high carbon, alloy and stainless 3/16" maximum.**

The Lewis No. 4FH is typical of the new developments Lewis engineers have perfected to meet tomorrow's production schedules today. For example, the amazing No. 4FH, designed for straightening and cutting short lengths, can produce 18,000, 12"–18" lengths of 1/4" welding rod per hour.

Now, Lewis announces a further development, the new No. 4FHA, designed for straightening and cutting any length at speeds up to 500 FPM. The No. 4FHA is a high-speed Travel-Cut Flying-Shear model equipped with Air Clutch and Air Brake.

A compound sliding gear transmission has six flywheel speeds and 20 feed speeds through the range of 75 to 520 FPM, permitting the selection of the correct speed for various diameters and materials.

There are 46 models in the Lewis line designed to handle wire from .012" to 1" in diameter. Write us . . . we have a machine to meet any wire straightening and cutting requirement.

**THE LEWIS MACHINE COMPANY**
3441 East 76th Street • Cleveland 27, Ohio
A Division of Curtis Mfg. Co.

# TRAMRAIL-EQUIPPED ROD STORAGE

This large structure was especially designed to accommodate a Cleveland Tramrail crane and hairpin-hook. It has enabled an impressive reduction in rod storage and handling costs. Size is 60'-0" x 160'-0". Crane runway is 200'-0" long. Height floor to roof truss is 35'-0". Storage capacity is 2500 tons.

The cost of storing and handling rod has been reduced to a very low figure at the Frost Steel and Wire Co., Ltd., Hamilton, Ont., with an open, roofless building which was built especially for the installation of a Cleveland Tramrail crane with hairpin-hook carrier.

The 160'-0" long structure is provided with unusual cantilever trusses for supporting the three archbeam tracks of the crane runway which extend 20'-0" beyond both ends of the building. These overhangs permit the crane to run over spur tracks of the Canadian Pacific Railroad at one end and the Canadian National Railway at the other end of the frame-work. Thus, rod can be lifted out of railroad cars and placed directly into storage.

On some days 8 cars of rod, or 400 tons, are brought in. The coils are piled eight high. At least double the amount of rod received must be handled, since the crane also has to move it out of storage. The work is taken care of completely by the operator in the crane cab.

The storage areas of many wire and rod plants, both large and small, are equipped with Tramrail systems for either horizontal or vertical coil storage.

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THE CLEVELAND CRANE & ENGINEERING CO.
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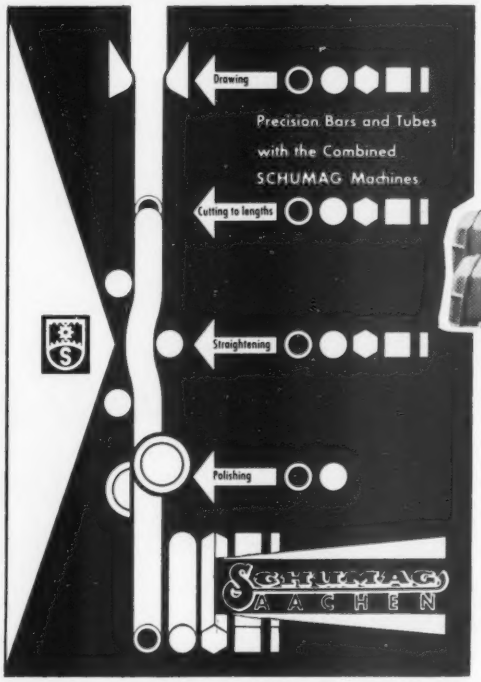
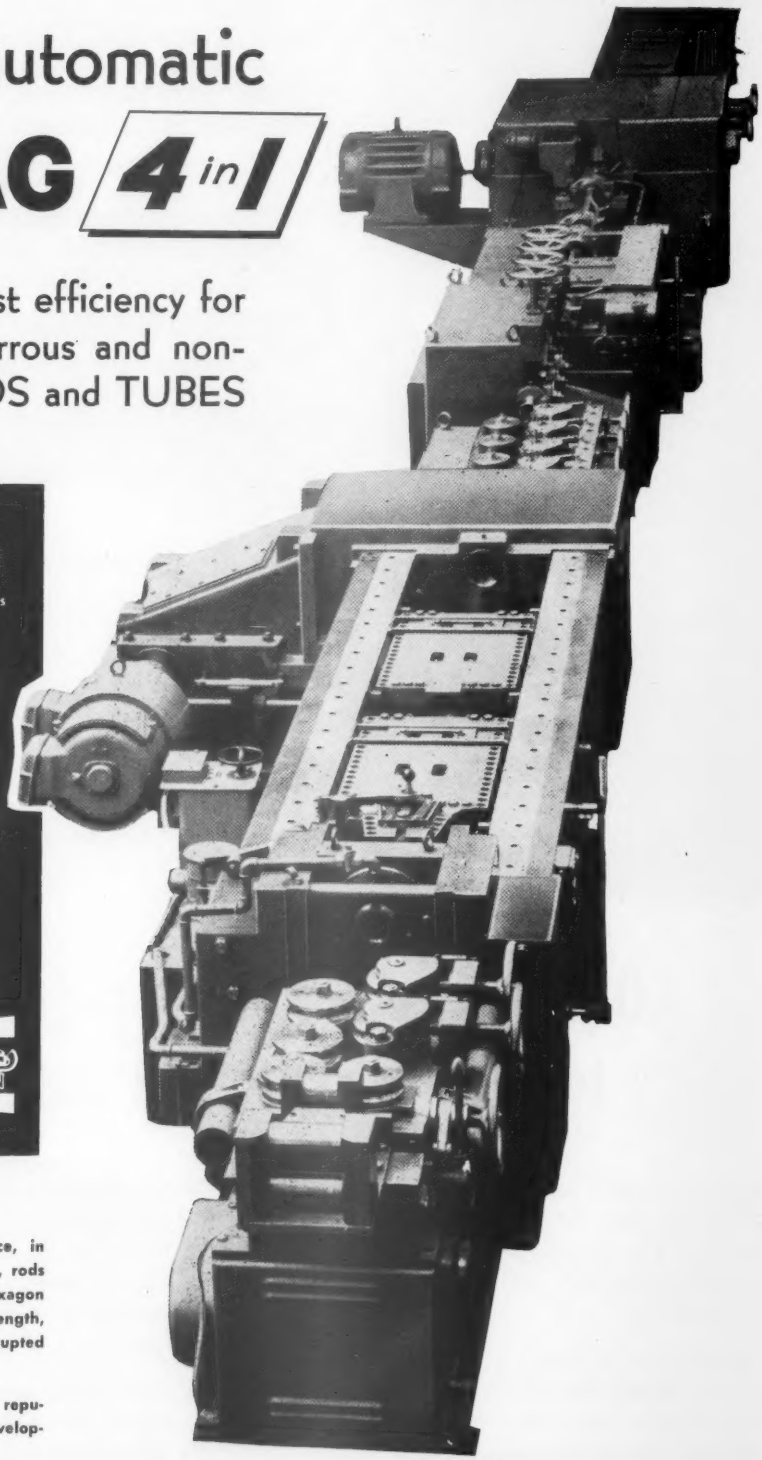
**CLEVELAND TRAMRAIL**
**OVERHEAD MATERIALS HANDLING EQUIPMENT**

# The fully automatic SCHUMAG 4 in 1

ASSURES... greatest efficiency for manufacturers of Ferrous and non-Ferrous BARS, RODS and TUBES



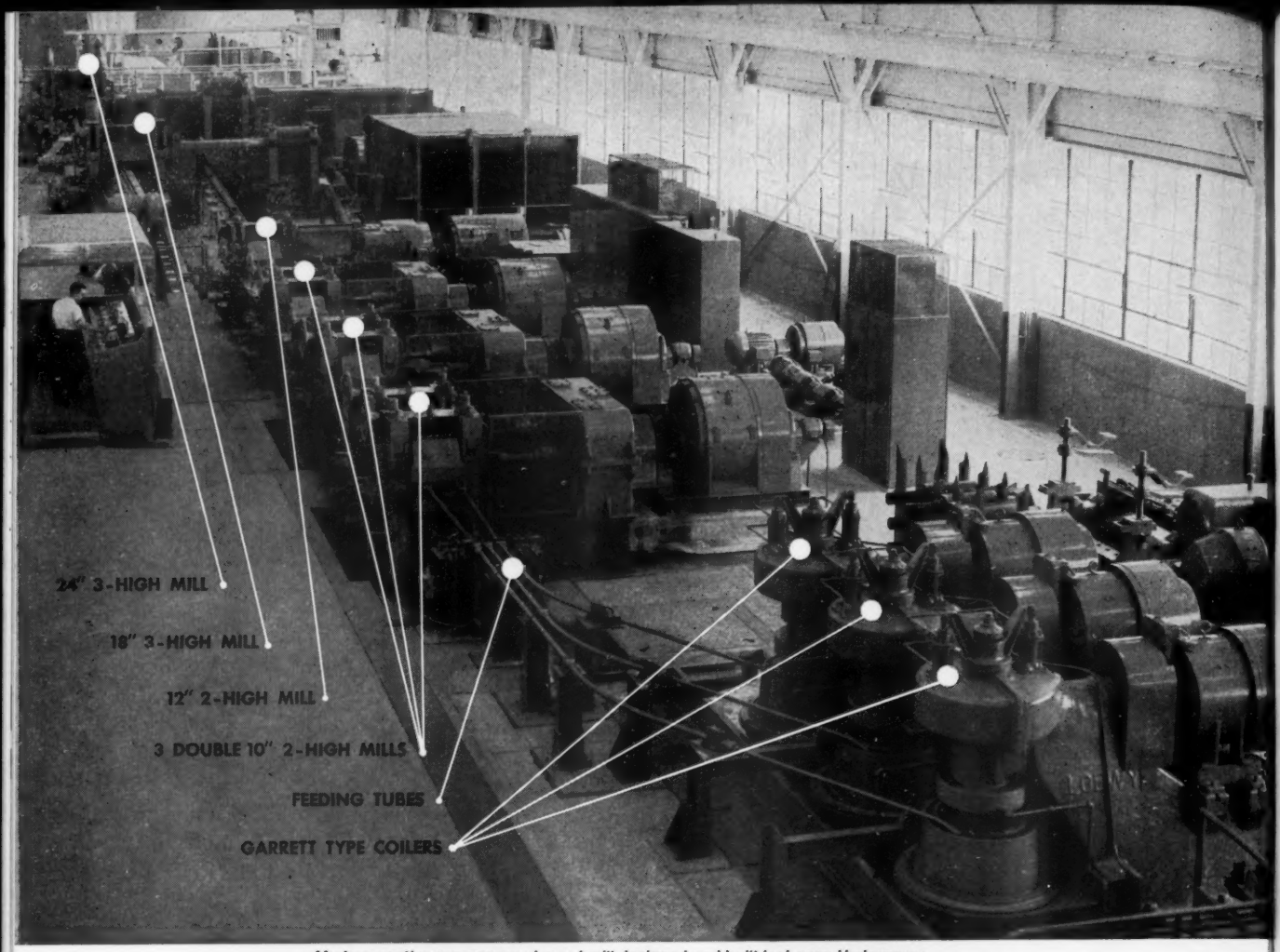
- SCHUMAG "4 in 1" machines produce, in one continuous operation, finished bars, rods and tubes from round, square or hexagon material. They will finish draw, cut-to length, straighten and polish in one uninterrupted sequence.
- SCHUMAG "4 in 1" enjoys world-wide reputation as the ultimate in technical development.

*Exclusive Representatives for U.S.A. and Canada*

**AMERICAN LAUBSCHER** *Corporation*

**SCHUMAG AACHEN**

**Fisk Bldg., 250 West 57th Street, New York 19, N.Y.**




Modern continuous copper wire rod mill designed and built by Loewy-Hydropress.

# LOEWY wire rod mills reduce wire bars to 5/16 in. wire rod automatically

This Loewy copper wire rod mill, which has been in successful operation for 2 years, rolls 5/16 in. wire rod from standard wire bars in a continuous operation. It is fully automated and all phases are controlled from one pulpit.

In addition to excellence of product, the owner is extremely pleased over the fact that, due to automatic operation, this installation permitted him to start operations with an inexperienced crew.

Whether you are a user or producer of wire rod, your competitive situation probably calls for equipment which functions flawlessly and with minimum personnel. Careful economic study might well reveal that the installation of a wire rod mill would be highly profitable for you.

Consult us—without obligation—on a mill which will answer your individual requirements for wire rod. Write Dept. I-12.

**Loewy-Hydropress Division**

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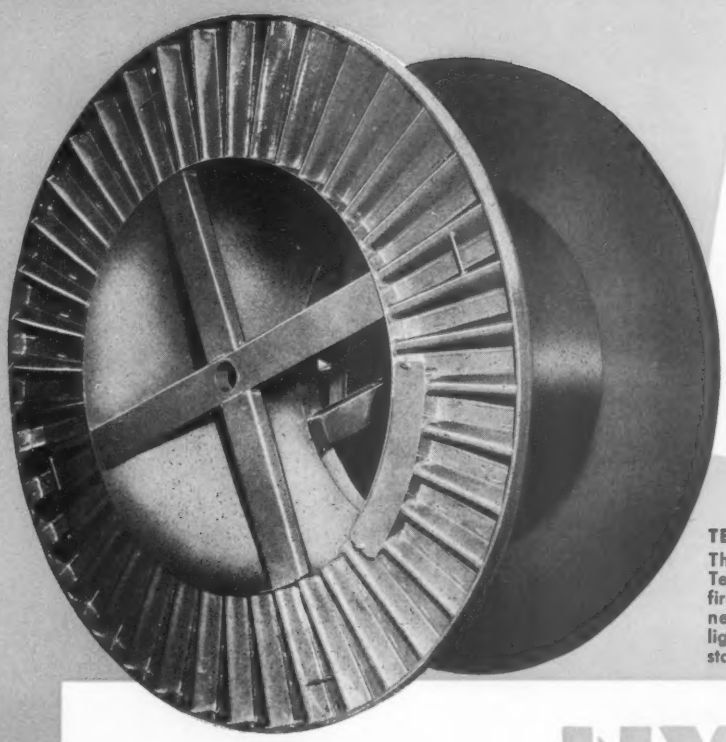
*Proven By Actual Test!*



**NEW YORK TESTING LABORATORIES, INC.**
CHEMICAL, ELECTRICAL, METALLURGICAL AND MECHANICAL
Engineers
TELEPHONE • BOWLING GREEN 9-6330-9
47 WEST STREET
NEW YORK 6, N. Y.

March 9, 1959

New York Engineering Company
75 West Street
New York 6, N. Y.

Gentlemen:

We have tested your "NYECO" Light Weight Steel Reel, 78" x 48" x 36" traverse, Drawing Number S1015, and offer the following comment with reference to our Test Report:

ASSUMING A CONSERVATIVE SAFETY FACTOR OF 2 BASED UPON YIELD STRENGTH, IT IS OUR OPINION THAT THE CABLE REEL CAN BE SAFELY LOADED TO 16,650 LBS. WITHOUT DISTORTION.

Very truly yours,
NEW YORK TESTING LABORATORIES, INC.

RH:awk

Roger Harvey
Managing Director

ANALYSIS—INSPECTIONS—LITIGATIONS—SURVEYS AND TESTS ON ALL MATERIALS, PROCESSES AND PRODUCTS

**TESTED AND APPROVED!**
This letter from New York Testing Laboratories, Inc. confirms the superiority of the new NYECO smooth-faced, light weight steel reel over standard reels.

## ANNOUNCING THE NEW NYECO

## SMOOTH-FACED LIGHT WEIGHT STEEL REEL

**NOW AVAILABLE FROM NYECO . . .**

greater protection against damage in shipping and processing with this rugged, weather-resistant, warp-proof, NYECO Steel Shipping Reel. All reels are furnished with four cross-arms unless otherwise specified. Drive-holes optional. No die charges or extras . . . any drum diameters or traverse. Flange diameters 42" to 90" inclusive.

**NYECO ALSO MANUFACTURES**

- Impregnating Tanks
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**YOUR INQUIRIES WILL RECEIVE OUR PROMPT ATTENTION**

Send specifications for STEEL SHIPPING REELS, IMPREGNATING REELS, PROCESSING REELS, SUBMARINE CABLE REELS AND BRIDGE REELS. Prompt deliveries on large or small orders.

***ANY QUANTITY—ANY SIZE—***
***ANY LOAD FLANGE DIAMETER***
***from 42" up***

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## why make parts the slow, costly way?

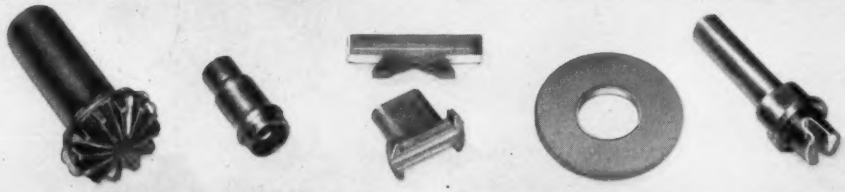
# COLD-HEAD THEM!

**Steel**

Tappet plunger, splined square-head shaft, collar for adjustment wedge, universal joint bearing cup, pipe plug, spark plug body.

**Copper**

Ornamental stud, distributor cap center insert, commutator bar, wire clamp, solenoid contact, starter field terminal.

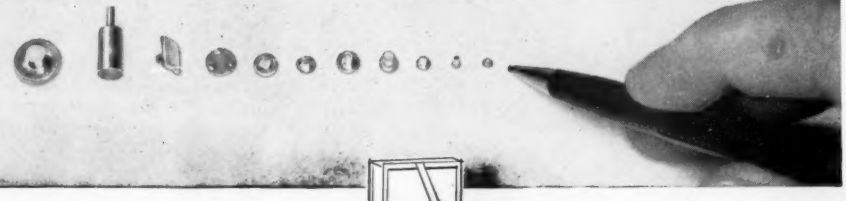


**Aluminum**

Hollow rivet, blind rivet, flanged collar, link, distributor cap outside insert.

**Precious Metals**

Electrical contact, transistor case, miscellaneous rivets and electrical contacts.



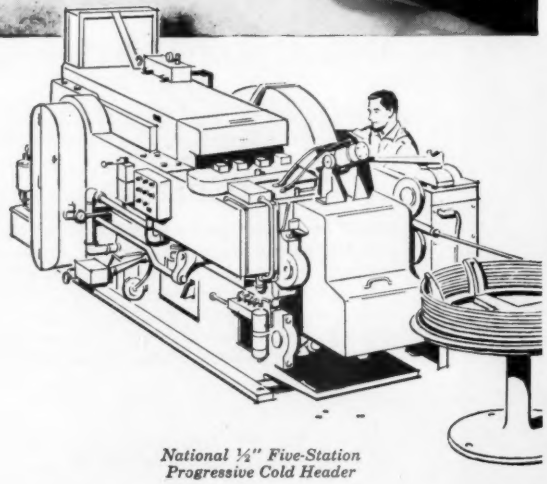
Of various metals, the parts identified above were developed for fast, accurate production on National Cold Headers.

Most of these important jobs are made without waste, ready for end use. All are cold-forged from coiled wire – start-to-finish in one compact Header – without any intermediate steps.

New technical break-throughs are making jobs like the above every day commercial realities. More workable wire, better lubricants, improved die materials and vast engineering experience are combining to adapt formerly difficult work to modern, profitable methods.

Whether you now have Headers or not, send us prints or samples of your jobs, or bring them to Tiffin where more of our people can help with *your* problem.

Perhaps up-to-date Cold Heading, a truly fast-growing process in metalworking, can pay off for you.



*National ½" Five-Station Progressive Cold Header*

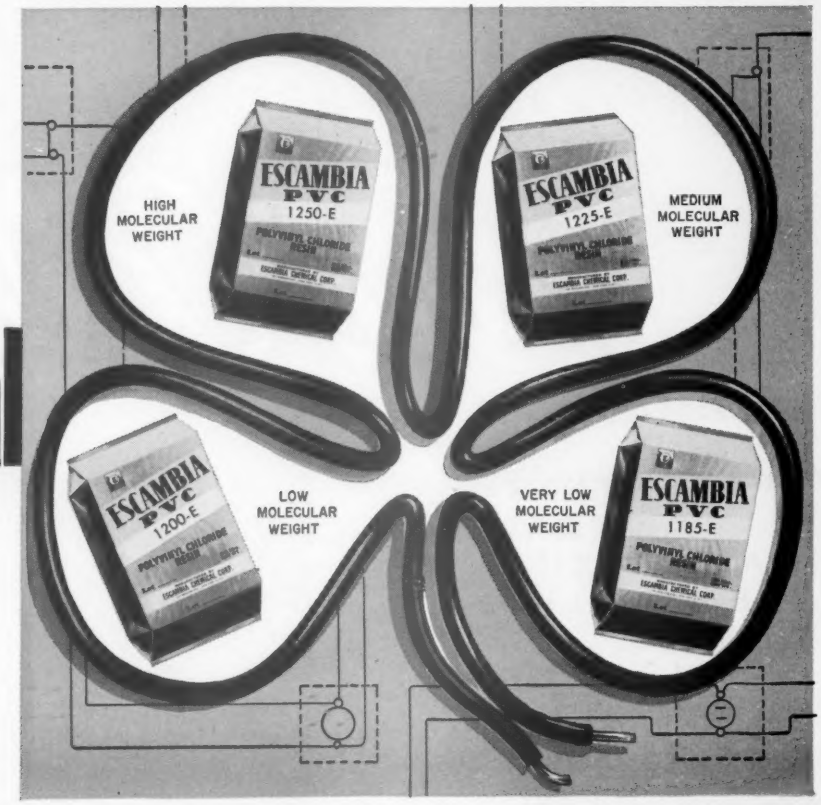
*Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS*

## NATIONAL MACHINERY CO.

*TIFFIN, OHIO, U. S. A.*

HARTFORD DETROIT CHICAGO

# FOUR Electrical Grade Resins




## *FIT EVERY REQUIREMENT*

**most complete line of electrical grade PVC resins enable you to:**

- Choose the resin best suited to your equipment
- Be assured of maximum production without sacrificing quality

If you are one of those who think there is ONLY ONE resin for your operations, it may pay you to make sure you are using the RIGHT ONE. Others have.
Write today for samples and specifications.

*Put these advantages of Escambia electrical grade resins to work in your product:*

- **Free-flowing dry blends**
- **Extremely low gel count**
- **Excellent color and clarity**
- **Uniform particle size**
- **Freedom from fines**
- **Outstanding heat stability**

**ESCAMBIA CHEMICAL CORPORATION**

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# COULTER & McKENZIE
## ANNOUNCES THE WIRE INDUSTRY'S MOST VERSATILE
## TAKE-UP & WIRE PACKAGING MACHINE!

# Vari-Coil

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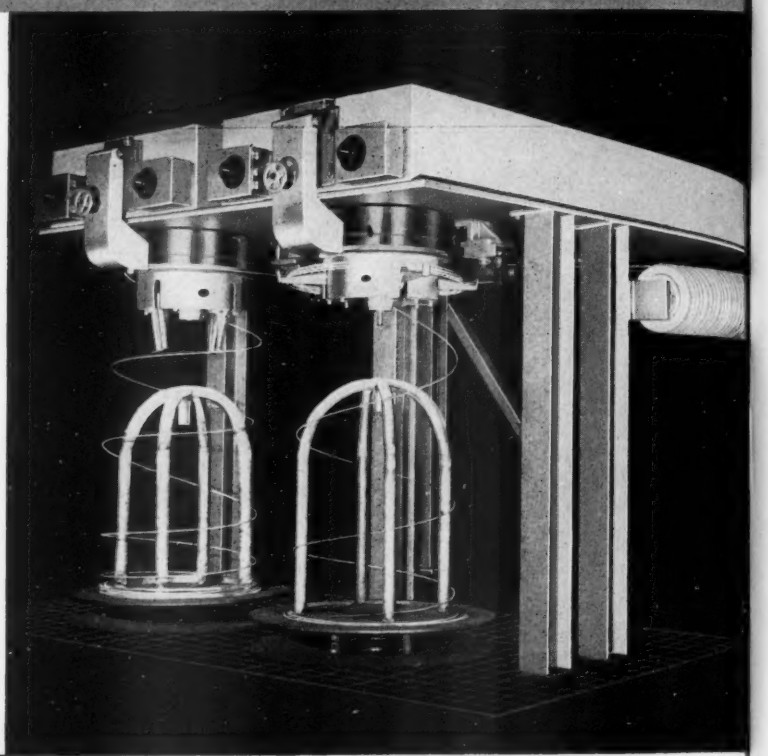
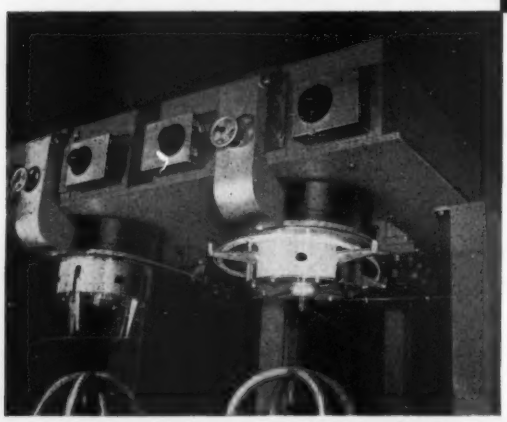
FINAL DRAW

- √ Non-Stop Package Changing
- √ Package Sizes to 4,000 lbs.
- √ Coil Diameters to 36″
- √ Speeds Infinitely Variable
- √ Wire Size to ⅜″ (.375″)
- √ Ferrous and Non-Ferrous Materials Including High Carbon Steel

**THERE IS A SIZE FOR ALL APPLICATIONS. SINGLE OR MULTIPLE UNITS FOR YOUR INDIVIDUAL JOB.**





For information concerning your application, please write or telephone.

**1 INFINITELY VARIABLE RANGE OF COIL SIZES**
a. All sizes wire from same capstan.
b. Current models with coil ranges 16″ to 26″ and 24″ to 36″ without changing blocks.
c. Coil sizes may be altered without stopping.

**2 GREATER COIL WEIGHTS**
a. Turn tables accommodate coils, drum paks and stems (200 to 1200 lbs.)
b. Oversize loads on handling pallets (1000 to 4000 lbs.)

**3 INCREASED RANGE OF WIRE AND ROD SIZES**
a. Precise cast control of fine wire to coarse rod.
b. No axial twist.

**4 ACCUMULATOR HEAD PROVIDES INTERVAL FOR STRIPPING AT OPERATOR CONVENIENCE**
a. Accumulator operating in conjunction with main take-up block is key to uninterrupted constant speed take-up.
b. Operator has 5 to 10 minutes accumulation time for stripping finished package from turn table.

This equipment manufactured under one of the following U. S. Patents 2,732,060; 2,868,474; 2,844,416; 2,868,268 or others pending.

Barron & Crowther Ltd., Eastleigh, England. European Draw-Pak Licensees Idos Industries Ltd., Royston, Herts, England, Sales Agents.

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THE COULTER & McKENZIE MACHINE CO., INC.

CONNECTICUT U.S.A. INCORPORATED 19[illegible]

# The Wire Outlook

While everyone except the steelworkers' leaders may rejoice that steel soon will be flowing into industry channels again, it will take many months to catch up with demand and overcome the disrupting influence of the shortages where the lack of steel has caused widespread shutdowns. The effects have reached into many branches of industry — autos, appliances and construction being some of the major ones.

What will happen at the end of the cooling-off period is a large question. The Congress appears to be aroused to the need for enactments that will curtail union power and make a repetition of this experience unlikely, if not impossible. Yet it should not be overlooked that labor is readying to have the laws "liberalized" to provide its leaders with greater power. To accomplish this there undoubtedly will be a resort to the old intimidation pressures on our solons individually.

The denunciations and defamatory statements heaped upon our chief executive are evidence that there is no such thing as enlightened statesmanship on the part of CIO-AFL and UAW leaders. Nor do they appear to be endowed with an understanding of democratic procedures, of economic laws, or of the American way of life, the San Francisco grilling of Mr. Khrushchev to the contrary.

Even granting a slow recovery from the effects of the strike, most business executives expect that 1960 will show substantial gains in activity and prosperity. Speaking before the NEMA convention last month one business consultant stated that the steel strike and tight money "have taken the bloom off the boom" and the balance of the year will be poor. The boom may resume in 1960, quite possibly be followed by a recession in 1961, but will brighten again in 1962, which will be the beginning of a bigger-than-ever boom, the speaker felt.

Right or wrong, about 25 percent of our economy is dependent upon steel, whereas only 5 percent is represented by the steel industry itself.

A major problem facing the country still is inflation. The wage-price spiral in steel has been paralleled by increases all along the line. The result has been the pricing of many American-made products out of domestic and foreign markets, or, as so often has been said, to "export jobs." A lot of manufacturers have been having products or product components manufactured abroad, just to be able to sell at home. Every such arrangement creates jobs abroad, eliminating a corresponding number at home.

Unfortunately, government intervention in strikes for many years has caused steel wages to go up faster than they might otherwise. Our old friend, Harry Truman, commented during the strike to the effect that if he were president he'd see that labor got what it asked and put them back to work. It is loose thinking like this that has brought about many of our present problems.

Wire mills have substantial orders, most of which cannot be filled until the first quarter. Defense projects will have priority and beyond that rods and wire will have to be meted out according to the best judgment of the producers. There will be a big rush to build inventories, which, in itself, will spur recovery. Wire, with its manifold forms and metals, is an important branch of industry. It has lagged behind other industries in its recovery from the 1958 recession chiefly due to the price advantages of foreign-made materials. This is true, not only of steel, but of copper-base alloys. Copper and aluminum have not suffered to the same degree, even though electrical conductor manufacturers have problems stemming from both domestic and foreign competition.

Only one step can be taken at a time. 1960 looks favorable. We shall have to take the next steps when we come face to face with the future.

Edmund Duval Sickels
EDITOR

**VAN MILLER**
*president*
**R. H. MILLER COMPANY, INC.**

"For fifty years we've worked with companies who know how the correct wire drawing lubricant or compound can affect quality and economy of production.

"It's been a rich fifty years. This working hand in hand with our customers toward the improvement of their products—has, inevitably, given us a wealth of experience in our own specialization . . . the manufacture of the "STEELSKIN" lubricants and coating compounds that have become a byword in the wire drawing industry.

"And so, at this season of cheer and good will which marks the close of our 50th year, a heartfelt 'Thanks' from all of us at R. H. Miller."

R. H. MILLER COMPANY, INC., HOMER, N.Y.

WIRE
AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 34 DECEMBER, 1959 No. 12

# Vacuum Annealing of Wire

by

Karl H. Fritz
Director

and

Georg A. Michael
Manager

Ofenbau Fritz G.m.b.H.
Hagen, Germany

This paper was presented by Mr. Michael at the Annual Convention of The Wire Association on October 14, 1959, at Cleveland, Ohio. Following the discussion that ensued, David M. Schmid, President of Techalloy Company, gave a supplemental talk and R. J. Perrine, of the Electric Furnace Company, described a continuous vacuum annealing furnace that his company is expecting to bring out soon. These two comments will be published in the January, 1960, issue of Wire and Wire Products.

Not only the production of wire, but also the subsequent manufacture of products from it, requires heat treatment processes, for which mainly industrial furnaces are used. The purpose of this paper is to provide information about an innovation offered by a German maker of furnaces.

* * *

It is true that we have not yet reached the stage when atomic heat furnaces can be used; nevertheless improvements and new developments have been introduced in recent years that should be of great interest. It should not be overlooked, however, that even in this atomic age traditional furnace designs, many old fashioned types are still in service. Unfortunately it is not always recognised that in such cases savings are effected in a completely wrong place. We hope this paper with its data and evaluations will provide a stimulus for the owners of older furnace installations to give serious consideration to advanced types, because not only do modern furnaces operate more economically, but, what is most important, they ensure a better quality and prevent both scrap and expensive manufacturing breakdowns.

* * *

It is well known that for the manufacture of wire, both intermediate annealing and final annealing is necessary. For this, the pot annealing furnace is used which, in the form of the shaft annealing furnace, had been known to our great grandfathers.

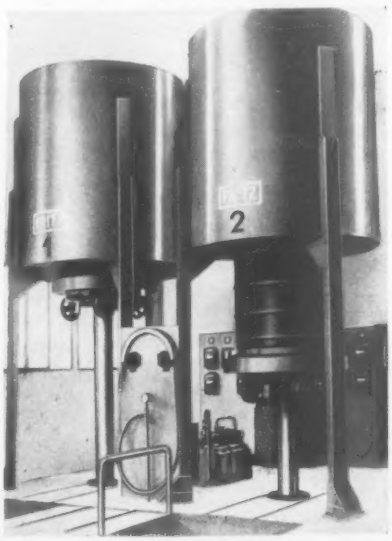



Fig. 1 — Heating hood mounted on columns.

* * *

Today special attention should be paid to a furnace with a **fixed** (stationary) heating hood, which offers many advantages as compared with the movable heating hood. These advantages are due not only to the annealing furnace itself, but also to the advantageous design of the whole furnace installation. The heating hood (annealing furnace), **Fig. 1**, is mounted solidly on columns.

* * *

The annealing pots are designed to be moved on wheels and rails or to be transported by means of a hand-operated lifting truck and they are introduced hydraulically into the raised heating hood. Fig. 2 is a cross section of the whole furnace aggregate.

* * *

A thicker insulation layer is incorporated, as compared with a movable heating hood, because, to save weight, this hood is insulated only to the strictly necessary extent. The annealing furnace with a fixed heating hood does not necessitate a heavy travelling crane, but only a light manual or electric hoist for lifting-off the thin-walled

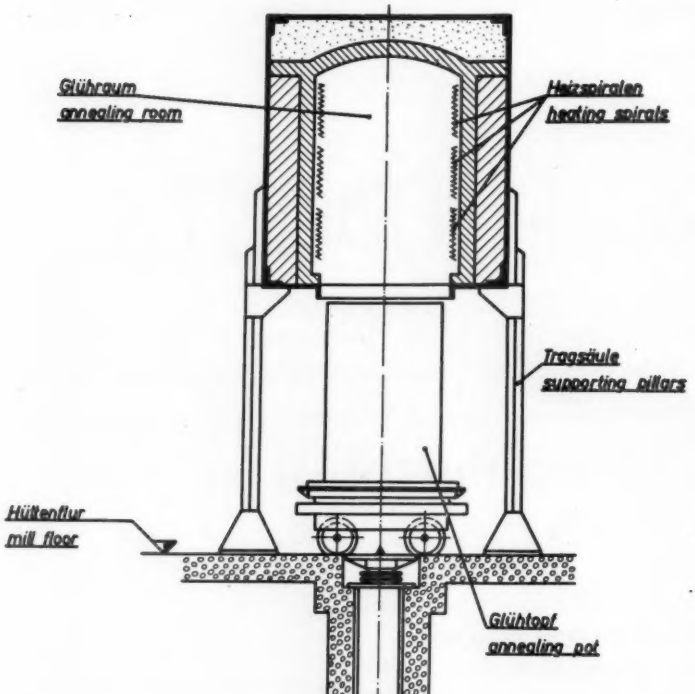



Fig. 2 — Cross-section of the furnace.

annealing bells. As a matter of fact, the hydraulic equipment is cheaper than a crane installation for lifting and lowering the entire furnace. As shown in **Fig. 3**, also

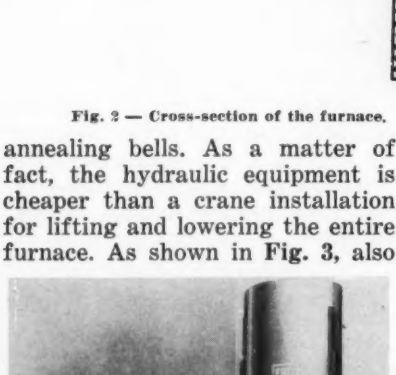


Fig. 3 — Hydraulic lowering platform

a hydraulic lowering platform can be installed, which makes possible the easy emptying and filling of the annealing pots. The latter can be lowered as deeply as required by means of the hydraulic piston, so that the annealed material (coils) can be removed at a convenient body and floor height, or can be placed on the table of the base of the annealing pot. Furnaces of this construction have been installed in many cable works for bright annealing under vacuum, but they are also employed with the same advantages for other annealing purposes as well as for annealing with protective atmosphere.

* * *

It is most useful to bright-anneal copper in the form of wire, strip, tube, etc. under vacuum. The pot used for vacuum annealing consists of the thin-walled annealing bell and the heat-insulated annealing base (table). The annealing bell is normally made of plate gauge 4 to 3 (A.S.W.G.) (5 to 6 mm — 13/64" to 15/64") and has a reinforcing ring at its lower part. The annealing base is equipped with a solid rubber packing carried in a profiled ring. Cooling ducts are arranged on the reinforcing ring of the annealing bell as well as on the profiled ring; by means of flowing water the rubber packing lying in itself completely dry, is kept cool during the entire annealing cycle. This special device, protected by many patents, guarantees not only a long life of the rubber packing (from 18 to 24 months), but also a reliable vacuum-tight sealing of the bell against the base. Moreover — and this is very important — it prevents the cooling water from entering under the bell. If this were not so, as for instance it might happen with the so-called "open lying water packings", an explosion could be caused by water sucked in under the bell by the vacuum in the pot.

* * *

**When** the pot is loaded with the material to be annealed, the first evacuation takes place by means of the water ring vacuum pump, which takes from 15 to 20 minutes. Then, the annealing pot is lifted up into the furnace by means of the hydraulic ram. After one hour or so, i.e., during the annealing process, a second evacuation takes place; finally, the third evacuation is made when the proper annealing temperature is reached, for example, when the pot has been lowered from the furnace. The second and third evacuation require each about 5 minutes.

* * *

**By** evacuating the pot, the vapors which originate from the lubricants during the heating-up period are partially removed and therefore can not settle on the wire surface.

* * *

**The** cooling-off is likewise effected under vacuum so as to avoid oxidation of the annealed wire.

* * *

**A** perfect high vacuum is not necessary. Vacuum from 3-5%, referring to the absolute pressure, is sufficient for obtaining a perfectly bright annealed copper or low carbon steel wire.

* * *

**Stainless** steels or other special

alloyed materials cannot be annealed in the prementioned furnaces, as in this case much higher temperatures than for copper or low carbon steel annealing are necessary.

* * *

**For** special requirements annealing bells with thick-walled, heat-resisting material can be employed which permits annealing up to about 1500°F.

* * *

**For** bright-annealing copper wire the method described above has proved far more successful than annealing under protective gas, not only because the working method of a vacuum annealing plant is so simple and its operating costs are cheaper than in conventional installations, but also because practice shows, as a matter of fact, that a non-sticking, mirror-bright wire down to .0008" (0.02 mm) can be obtained, which is particularly suitable for subsequent enamelling.

* * *

**This** fine result can be explained by the fact that the lubricants adhering to the drawn wire before annealing volatilize entirely under vacuum. As already mentioned before, the lubricant vapors are drained from the pot by means of the vacuum pump. On the other hand, during the heating-up period these vapors are welcome, as they form a kind of "protective gas" so that the material to be annealed is not heated only by radiation, but also by transmission or conduction.

* * *

**Annealing** under vacuum does by no means call for a longer time than the usual annealing with protective atmospheres. When annealing under vacuum not only the cost of the purchase of an expensive gas producer is saved; but also maintenance and operating costs for this installation are lower. Electric current consumption — full vacuum annealing furnaces are only built for electrical heating — is from 55 to 80 kwh for copper and from 160 to 220 kwh for low carbon wire, depending on charge weight and annealing temperature applied.

* * *

**For** annealing low-carbon wire two different annealing methods can be employed. With very fine wire which perhaps is suitable for making wire glass netting, annealing is effected under vacuum in an electrically heated furnace, the same as for copper. The annealing temperature for this fine steel wire is about 1150°F. The annealing bells are made from heat-resisting steel. If higher temperatures are necessary, as might be the case when annealing coarse wire, the vacuum in the annealing pot should be created only when the heating-up period is finished, i.e., it is only the cooling-off cycle that should be effected under vacuum. The so-annealed wire will then have a **white** and not a bright, brilliant surface. Practice shows that bright, coarse wire is scarcely required, since it is mostly used for re-drawing or for galvanising purposes. Consequently, in most cases this "semi-vacuum method" will be sufficient for annealing coarse wires.

* * *

**The** furnace, in this latter case, can be heated by electricity, by gas, or by oil. Of course, it can also be used for annealing wire under protective gas, i.e., for protective gas flushing or circulation.

* * *

**It** is particularly for gas and oil heating that the stationary heating hood is especially advantageous, as all pipe lines, like the electrical cables, are laid **fixed** to the annealing furnace. There are no flexible conduits, which can cause operating troubles with the movable heating hood. The necessary cooling-water pipe lines are also fixed.

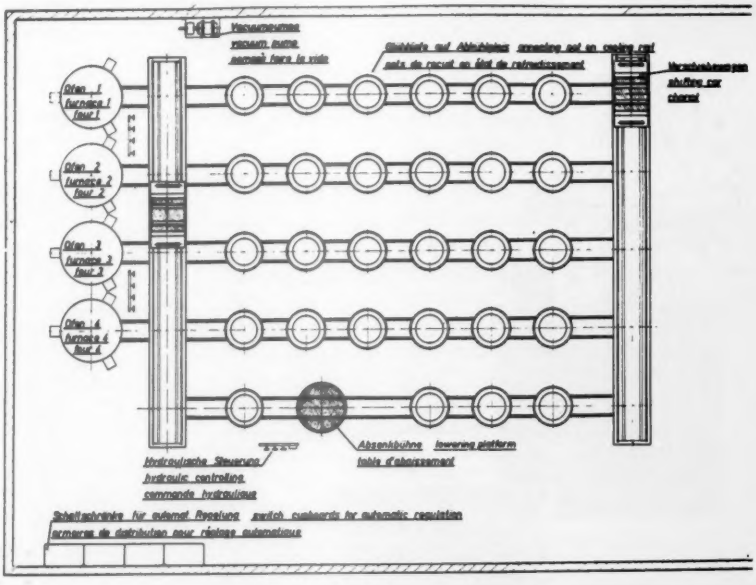
* * *

**A preheater** can, in the case of gas or oil firing, be arranged to great advantage alongside the fixed heating hood or between two such furnaces. The waste gases are led from the heating hood through the preheater in order to preheat the cold annealing pot from 400-600°F (200-300°C). A saving of energy amounting to between 15 and 25% is obtained in this way, quite apart from the substantially increased throughput capacity.

* * *

As shown in Fig. 4, these modern annealing plants can be arranged with a particular economy in space. The charging place for the emptying and filling of the annealing pots is located at a definite point by the hydraulic lowering platform. Transport to and from individual "annealing sites", most-

(*Please turn to page* 1659)




*Aufstellungsplan - Blankglühanlage*
*Erection Plan - Bright Annealing Plant*
*Plan de Fondation - Installation de Recuit*

**Fig. 4 — Erection plan for a bright annealing plant.** * * * * * * * * * * * *

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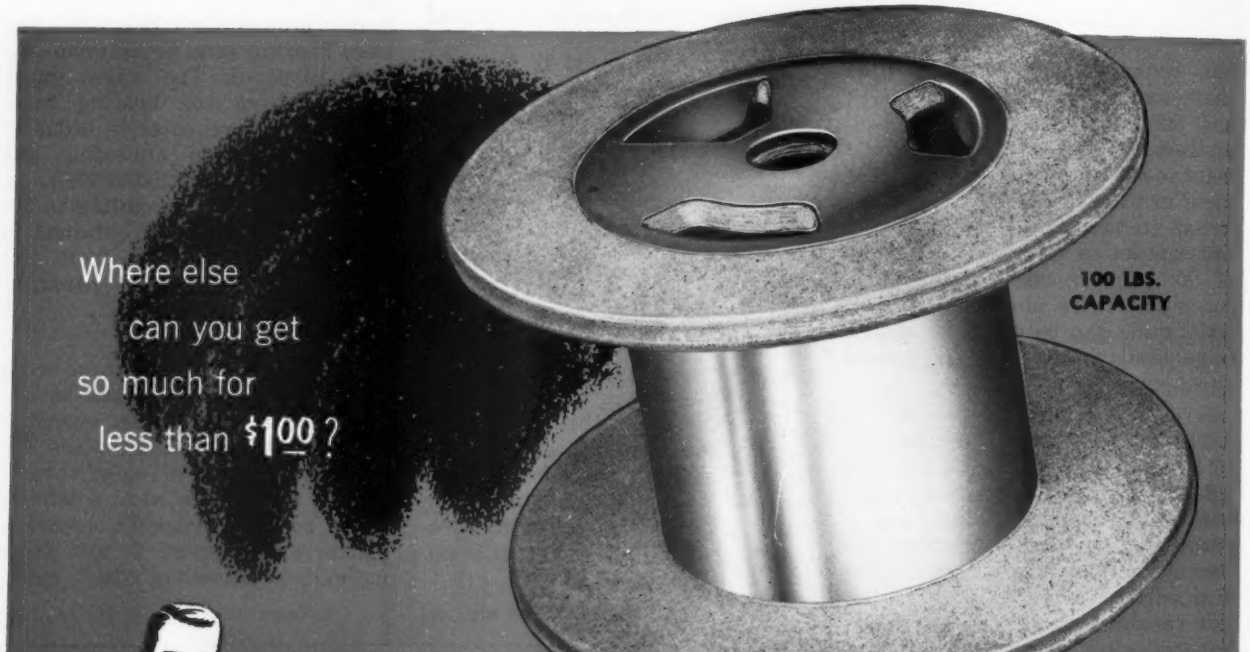
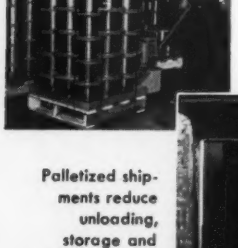


Hand slots
for lifting



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|---|---|---|---|---|
| Flange | Traverse | Bbl. | Arbor | Flange Thick. | |
| 12 | 8-12 | 6½ | 1¼ or 1½ | 7/16 | |
| 12 | 6 | 6½ | 1¼ or 1½ | 7/16 | 5.25# |
| 12 | 7 | 6½ | 1¼ or 1½ | 7/16 | 5.5 |
| 11 | 6 | 6½ | 1¼ or 1½ | 7/16 | 4.8 |
| 11 | 7 | 6½ | 1¼ or 1½ | 7/16 | 5 |
| 11 | 9 | 6½ | 1¼ or 1½ | 7/16 | 5.25 |
| 10 | 6 | 6½ | 1¼ or 1½ | 7/16 | 4.0 |
| 9 | 6 | 6½ | 1¼ or 1½ | 7/16 | 3.5 |
| 9 | 6 | 6½ | 1¼ or 1½ | 3/8 | 3.3 |
| 9 | 8 | 6½ | 1¼ or 1½ | 7/16 | 3.75 |
| 9 | 8 | 6½ | 1¼ or 1½ | 3/8 | 3.5 |
| 9 | 9 | 6½ | 1¼ or 1½ | 7/16 | 4.06 |
| 9 | 9 | 6½ | 1¼ or 1½ | 3/8 | 3.8 |
| 8 | 8 | 6½ | 1¼ or 1½ | 1/4 | 3.06 |
| 8 | 6 | 6½ | 1¼ or 1½ | 3/8 | 2.1 |
| 8 | 6 | 6½ | 1¼ or 1½ | 7/16 | 2.7 |

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# Tension in Wire Engineering

by Dr. Erwin J. Saxl, President
Tensitron, Inc.
Harvard, Massachusetts

Paper presented at the Annual Convention of The Wire Association on October 13, 1959, at Cleveland, Ohio.

## Introduction

**Tension** is the smallest common denominator of all wire processing operations. Too little tension produces a soft coil or loose resistance windings. Conversely, excessive tension stretches the wire, narrows its diameter, and changes its intermetallic structure. Poisson's Ratio as well as deviations from it produce a set of mutually varying parameters which tend to influence the electrical resistance of a wire, its stiffness and magnetic susceptibility—to mention but a few out of many other variables. For all these and other reasons, deforming tensions cause lack of linearity of electrical resistance and local overheating ("hot spots") when current passes through the wire. This excessive strain first damages and ultimately breaks the wire. Yet even prior to ultimate separation, the current carrying characteristics of the wire are damaged.

* * *

**Actually** the current carrying capacity of a wire is but one of the several factors that indicate a change of state in the material. Beyond electrical and magnetic parameters, there is the important characteristic of behavior under stress and strain commonly called the strength of the wire.

* * *

**From** this viewpoint there exist great hopes for possibilities toward the systematic improvement of the material characteristics. It is based not only upon recent findings made with the advanced methods of today's physics and metallurgy. This art may be followed back over a span of a great many years. Reference is made to the world famous sword blades that the artisans of their day made for the samurai of feudal Japan. Their extreme strength, freedom from impurities, lasting sharpness under cutting impact and high flexibility is reported to have been achieved by a system of repeated foldings and hammering together of the material thus flattened. **In this manner intermetallic structure was added to chemical and metallurgical constitution.** There exists good reason for the working hypothesis that the alignment of the micro-metallic parts—whatever the name be that we would give them in the terminology of today's science — played a decisive part in their superb quality: the lateral compression from the hammering force, the carefully directed blows to shape the blade in combination with the original material as well as its heat treatment. This may be compared to the lateral compressive forces that a drawing die exerts upon the wire pulled through it, the gradual alignment of the micro-metallic wire structure as caused by repeated drawings together with the tensional characteristics and standard methods of manufacture that make such repeated forming processes possible.

* * *

**We** know already that we use but a minute fraction of the strength that is theoretically inherent in metals. Experiments with individual crystals show that the possibilities for improvements in the tensional characteristics of wire have a real basis in fact. Studies of single micro-crystals show that tensile characteristics amounting to several hundred percent of present material strength can conservatively be anticipated once the mechanism of combining them into adequate aggregates is illuminated by a better understanding of the factors underlying such arrangements—and industrial controls make the production of such a material a reality. Greater strength-to-weight ratio should then be anticipated, together with other improvements in wire characteristics.

* * *

**The** question of strength through structural alignment, be it by tension, compression or other physical factors may well lead the way here into an industrial revolution indicated only by the introduction of such materials of extreme strength and hardness as the carboloys of recent origin. These, in their way of making as well as use, indicate well what an improvement in strength may mean in terms of other materials.

* * *

**Forming** operations for wire—within which tension plays an important role—are limited by the extremes of strain that a wire can withstand. While high tensional characteristics are desirable, there are other factors that constitute good engineering reasons for using as little a tension as possible.

* * *

**Between** these extremes lie the Safe Tensions. They are influenced not only by the wire diameters, but also by the speed of winding, the physical and chemical conditions of the wire (such as its modulus of elasticity and hardness), dislocations within the microstructure of the alloy, its moment of inertia, and several other essential characteristics of the wire itself. In addition, there is the influence of the devices that apply tension upon the wire such as frictional detents and braking surfaces.

* * *

**The** measurement and control of tension is thus an intricate process involving longitudinal wire-extension, transversal contraction and micro-metallurgical phenomena. The physical processes involved are furthermore compli-

cated not only by the progressive alignment of the microscopic wire structure, but also by the mutually changing diameters of the dereeling as well as wound packages of wire forms, the speed-sensitivity of most tensioning devices and other processing constants. The total case-history of the wire, including the number of drawings, its annealing schedule, its alloy content and other factors, influence its hardness, ductility, and electrical conductivity. In addition, stretching (which may be considered a form of cold-working) influences the ferro-magnetic behavior of wires whose magnetic performance is significant.

* * *

**Strain** produces a change of electrical resistance that may be written in the form of $\frac{\Delta R}{R}$, in response to length changes, or $\frac{\Delta L}{L}$. This causes heating and other factors as described originally by Lord Kelvin.[1] For a thorough investigation of the effect of tension on the thermal and electrical conductivity of metals, reference is made to P. W. Bridgman.[2]

* * *

**Not** only does a magnetically susceptible, filamentous or tape-like material change its length upon application of a magnetic field (magneto-striction), but its permeability also changes as a function of mechanical stresses on the wire and of the alignment of its micro-structure. Thus a deeper understanding of magnetic domains, lattice constants and other details of the inter-metallic structure helps in the engineering of tensions that facilitate the handling of permeable wires and flattened as well as tape-like materials as used in magnetic recording devices and for covering submarine and other long-distance cables.

* * *

**Stress** on wires influences electrical resistance in the wires. From wire-wound strain-gages to precision wire-wound potentiometers the micromolecular arrangement is disturbed by tensional stress. Thus, the linearity of precise wire-wound resistors suffers, and burn-outs occur which can be shown as a function of $R^4$ for instance in tungsten filament incandescent lamps.

* * *

**In** view of these physical conditions, bending in the fine wires such as is caused by methods of tensioning that put a permanent crimp into the wires is a dangerous practice since tension is set up on one side of the wire's neutral axis and compression on the other side (Figure 1).

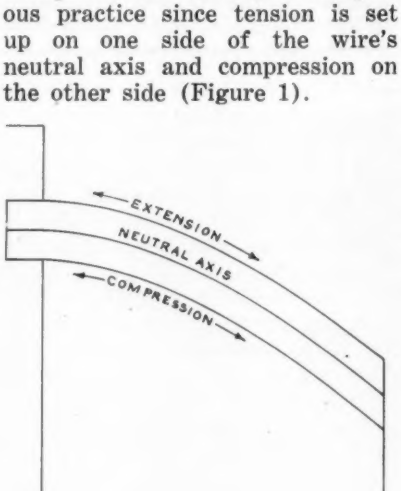



Fig. 1 — Extension and Compression within a Deflected Wire.

* * * * * * * *

**This** results not only in potential mechanical damage to the wire but also influences the density of current flow through adjacent differential parts of the wire crossection.

* * *

**Moreover,** in the insulated wires that play such an important role not only in wire-wound devices but also for the distribution of electrical energy and transmission of signals, we are not dealing any longer with the wire as such but with the complete system wire-plus-insulation. The development of improved covering enamels and lacquers for insulated wires falls, therefore, into the field of behavior of wires under stress. We are then dealing with a compound system whereby the extensibility of the cover must be adequate so that no cracks develop in the insulation. Brittle stress-coat (the opposite of the ideal plastically deformable insulating cover) shows where cracks and fissures develop in the insulation. If the extensibility and ductility of the wire exceeds that of the covering, this reduces its resistance against voltage breakdown. Insulation must solidly adhere to the conductive core and must have adequate extensibility so that insulation cracks and voltage breakdowns are avoided or reduced to a minimum. While such an ideal state can be achieved in theory only, it is feasible within the limits of engineering tolerances to practically eliminate it by making proper allowance for such engineering factors.

* * *

**Insulation** damage and deviations from the roundness of the crossection of the wire (as can be shown by the use of microphotographs[19]) are another factor that influences tension and causes still further tension variations plus the electrical and magnetic changes in response to the latter, since it influences the surface friction of the wire when it passes through frictional detents and thus changes in tensioning. This varies for different production methods and origins of the raw material. It may also change at times from lot to lot.

* * *

**Tension** in the making and processing of wires thus constitutes a complex problem of major scientific and engineering significance. A deeper understanding of the basic factors involved in handling wires underlies an increase in safe production speeds and the engineering of greater geometrical and physical uniformity of the coil or other wire-round products. Thus the making of better coils and potentiometers of greater precision as well as the increasingly effective use of wires of smaller diameters (in keeping with today's trend toward miniaturization) is virtually influenced by checking and maintaining proper tensions.

* * *

**Between** tension extremes where the wire and its insulation get irreparably deformed and damaged . . . to the opposite extreme where filamentous materials are laid around preformed shapes and mandrels too loosely, there is the comparatively limited range of tensions within which proper tensional tolerances can reasonably be maintained. These are the "Safe Tensions" within which all pre-

paratory processes for filamentous and sheet-like materials should be handled.

* * *

**These** vary with the type of material. Copper has a lower tensile strength than, say for instance, steel wire of the same diameter. At the other end of the scale where we are dealing with synthetics, the plastics that cover the wire may be overstretched to the point where they are damaged before the ultimate rupture of the wire. The combined tension and compression when the wire is laid around a mandrel is another case in point with reference to tension engineering particularly when the diameter of the coil form is small in relation to the wire crossection. Also, if these materials are laid around a bobbin with excessive tension, their composite total pressure has a tendency to crush the coil form.

* * *

**For** these and other good reasons, the determination first and maintenance thereafter of the right tensions for a given set of engineering requirements is essential.

## Static and Dynamic Tension Tests

**Heretofore,** the checking of tensional characteristics was essentially limited to the extreme that no tension ever should exceed the "Breaking Strength" of a given material.

* * *

**Contrary** to these **quasi-stationary conditions** that the laboratory tests provide, there is the behavior of these materials under the **conditions of actual performance encountered during production.** Here we are dealing with the **dynamic** tension, with the vibration of a wire or cable strained, the quick increase and decrease of longitudinal strain such as in starting a machine or when an object suddenly interferes with the smooth progress of a wire. In industry, we are dealing with **dynamic systems of quickly changing tensions.** What damages a material is then not so much the constant pull, but the sudden rise of the latter, the equivalent of shock for which no adequate compensation has been made beforehand.

**The** danger exists, therefore, that during processing a point is reached where the diameter and material constants of the wire or cable construction cannot safely support any longer the sudden load-increase. This is frequently the cause of damage — not the uniform continuity of reasonable strain that the material is designed to support fairly.

## Tension and Insulation Damage

**Such** a condition is shown on Figure No. 2 which shows a microphotograph of a fine enameled copper wire that has been stressed suddenly beyond its safe limits. Even before the wire core breaks we find under certain conditions that the insulation is damaged as can be seen under the microscope if not with the free eye.

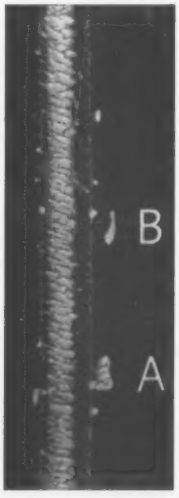



Fig. 2 — Insulation Damage on Wire Stressed Excessively.

* * * * * * * * *

**The** microphotograph offers evidence that at least two separate systems of damage have occurred in the plastic insulation. One consists of breaks approximately of spiral fashion. They surround the wire in a direction where it is nearly at a right angle to the length-axis of the wire. Clearly, the safe extensibility of the insulation was less in this instance than that of the copper that it covered.

* * *

**Going** one step further, after these initial fissures have been started we see at points A and B that insulation has already started to flake off. No wonder, then, when at such points insulation breakdown is initiated and as the damage grows progressively, a coil is subject to electric failure in proportion to the number of turns it contains and the ambient conditions to which it is exposed such as for instance reduced air pressure at the high altitudes at which electronic devices must today be operating with complete reliability.

* * *

**In** the system copper-plus-insulation a damage such as the one shown in Figure 2 is the exception fortunately rather than the rule. We are dealing, however, with a more serious condition when consideration must be given for a number of good engineering reasons to non-copper wires to which their insulation should be bonded solidly. Among these conductors that are other than copper, particular reference should be made to the rare metals. For instance platinum wire does not have as yet always a reliable bond with its enamel covering. This condition becomes worse when the platinum is annealed. A similar condition, moreover, is known to exist in gold and other rare-metal wires the chemical constitution of which precludes the oxide layer between metal and insulation which helps the adhesion of lacquer to metal. By their very nature, the rare metals do not oxidize under normal conditions or enter easily into compounds that would facilitate adhering of the plastic to the metal wire.

* * *

**Considering** the cost of fine platinum wire and the labor of winding, it, a well-known manufacturer stated recently that every short-circuit in a precision coil of insulated platinum wire of their make causes them a loss of $10.00 worth of insulated platinum wire plus another $10.00 worth of labor. These amounts, moreover, are out-of-pocket loss and do not include the reasonable overhead with which any plant that is run on a business like basis must consider. The plain fact that the frictional tensioning devices that were used in that instance caused abrasion of the insulation first and that this original defect was compounded thereafter by causing the wires to be stressed with irregular tensions which in turn produced unevenly spaced coils indicates dramatically the necessity for im-

proving tensions in winding insulated precious metal wires.

* * *

**Apart** from the check for the extensibility of the system wire-plus-insulation, this method also furnishes an excellent tool for the investigation of stress distributions in the wire and of strains caused by the wire passing around sharp corners and through obstructions. Methods of stress-coat analysis by the use of brittle lacquer techniques and the use of photo-elastic methods based upon this phenomenon (3-8) lend themselves well for the further systematic analysis of these as yet little known factors which greatly influence the performance of wires and the products that they form.

* * *

**Fortunately,** with modern plastic insulating materials an occurrence such as the one shown is comparatively rare. Whereas properly compounded plastics as a rule have now a higher extensibility than the metallic core they cover, the process as such is of importance to show **uneven building-up of stresses IN a wire.** Contrary to general opinion, stress does not find even distribution over the surface of the wire nor is it homogenous in its interior. It is non-uniform instead. Material is actually heterogenous. Analysis of stresses in wires using brittle lacquer techniques, as well as photo-elastic and other methods of stress analysis indicate this non-uniform behavior (9-13) at the wire surface. X-ray diffraction and determinations of electrical resistance include changes in the internal wire parameters as well.

* * *

**Despite** the apparent indication of health given by a continuity test, insulation may not necessarily cover the conductor at all points adequately and longer. Neither does the apparently undamaged surface necessarily prove soundness of the core. Electrical continuity indicates only that the conductive part of the wire actually has not been broken. Unless special methods are used, however, it does not necessarily indicate a **partial short-circuit within the coil,** a reduced insulation resistance or discontinuities in the inside of the core of the wire.

* * *

**Whereas** it was shown in the microphotograph of the enameled wire that insulation damage was caused by stretch, these conditions are even more pronounced upon bending of the wire. One of the severest tests for the wire is to bend it sharply at which time the insulation must stick. Physically speaking, the insulation is then extended on one side. Beyond the neutral axis it is compressed at the opposite side due to bending as was shown in Figure 1. A flaking off such as shown on the linearly extended wire will be found then at times, an important factor which is to be reduced to the minimum for wires that are subject to severe manufacturing or performance stresses. It is at this "locus minoris resistantiae" that wire damage finds its entering wedge in a vibrating rocket, in a coil exposed to high-decibel, high-frequency sound or even in as commonplace a process as the use of a frictional detent in contact with the wire.

* * *

**Aside** from the physical characteristics shown in the microphoto, wire impairment due to enamel-damage falls essentially into two categories:

**a.) *Physical cracks* that appear in all layers of the coil. Hereby, physical separation takes place of the enamel from the wire. Such separation cannot be healed. Better bonding methods between enamel and wire are needed then. (Certain novel approaches to this question show promise for better bonding.)**

**b.) *Crazing.* Crazing is produced by moisture in the air, also by alcohol, some solvents and certain waxes. We are dealing here with what essentially may be considered an irregular solvent absorption and its subsequent evaporation. (This is the physical basis on which wrinkle lacquers and similar crackle finishes are produced.) Crazing can be healed, at times, by heating the wire for a prolonged period. This drives the solvent out, the enamel melts and the wire is covered again.**

* * *

**This,** of course, can be made only in a limited number of instances. In a precise coil with multiple layers of fine, enameled wire which are closely packed from one wire to the other the adhesion of the lacquer to the base and the deviations therefrom may indicate a condition of change in the ability of the underlying core to conduct energy or oppose its propagation as an integrated function of the several strains to which it was exposed.

* * *

**Slippage** occurs on the crystal lattices and in the intermetallic structure under strain while heat is developed in the wire. Thus, a wire deformed under tension or subjected to other stresses shows not only differences in its caloric conditions as was investigated in the beautiful work by Lord Kelvin[1]) in 1856 and in 1923 by P. W. Bridgman[2]), but also its apparent Poisson's ratio is changed. This latter, the ratio of lateral contraction of a wire to its longitudinal extension within the elastic limit is given by

$$\sigma = \frac{\frac{\triangle L}{L}}{\frac{\triangle D}{D}} \qquad (1)$$

* * *

**It** is smaller than 1 **because the lateral contraction is but a fraction of the longitudinal wire extension** per unit length. As a rule it is between 0.2 and 0.4 for most solids. Hence upon application of a longitudinal strain, the volume of the wire will increase slightly.

* * *

**This** narrowing down of wire under stress beyond its limit of elastic recovery is a serious condition. When stretched to the point of "flow", a plastic such as a polymer will change its physical structure. By the same token, a pure metal or an alloy stressed beyond the point of elastic recovery will "stress-harden". A re-arrangement of the physical structure occurs then even if chemical analysis continues to show the same apparent constituents.

* * *

**It** will be seen from equation (1) that this condition is more serious than appears at first sight. Whereas the length (L) of the wire appears in this equation as a linear parameter, the crossectional conditions follow a square law ($r^2$). Hence even a comparatively modest increase in length is followed by a pronounced reduction in the critical diameter since the latter deformation follows an exponential function.

* * *

**Since** electric current heats a

wire according to the square-law function

$$T = I^2R \qquad (2)$$

it will be seen, therefore, that even apparently minor length changes produce a significant deviation from the current and load-carrying characteristics of an electric conductor. Not only is the crossection narrowed down in accordance with the square law, but in addition, since current changes follow an additional square-law function, the changes in the electrical characteristics are still further amplified when the wire is stretched excessively. Last but not least, the inter-metallic structure of the electrical conductor subject to such stresses changes its electrical conductivity . . . an effect which underlies the science and art of electrical strain gages and the stress analytical concepts based on them.

* * *

Safe tensions do not as much depend upon the final breaking strength as upon the load-extension characteristics of a wire. These differ from the initial material constants to the case history of work-hardening and annealing of each wire, to mention but a few of a larger number of variables. In the initial phase the load elongation diagram of some materials is quite steep (such as in the instance of the copper wire shown in Figure 3) and in other instances is flat as for instance in nylon (such as used in certain types of insulation) that does not become matured until it is stress-hardened by repeated stretch-spinning at elevated temperatures.

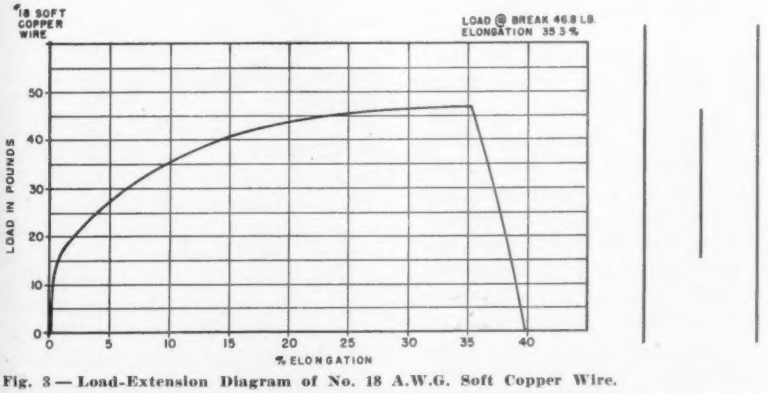



Fig. 3 — Load-Extension Diagram of No. 18 A.W.G. Soft Copper Wire.

Yet even this has limitations according to what the applications are under which the material must perform adequately. To present an extreme, a parachute cord of nylon, not entirely matured, will stretch when the parachute unfolds and the shock starts to elongate the cord. Simultaneously then the tenacity of the line increases. Thus, we have in this instance the example of a filamentous material, the characteristics of which **improve** upon stretch **for that particular application.** We are beginning, then, to think in terms of **tension engineering** rather than of ultimate tensile strength or a theoretical fraction of it.

## Influence of Plastic Flow and Cold Working

**Investigations** of this nature are made difficult by the fact that **all materials from metals to plastics are subjected to stress- hardening.** If stress beyond the limit of elastic recovery is used (that is to say beyond that range of the load-elongation curves wherein the load is linearly proportionate to strain and vice-versa as formulated originally by Hooke) we are dealing then, with a **material which near its ultimate strength is different physically from the one with which we started** the test. By deformation, stress hardening and narrowing down of the material, we get into an area of tensional operation wherein as we approach the breaking point we are not dealing any longer with the same physical material with which we operated at the beginning of the load-elongation curve. The lattice structure has changed (as can be shown by X-ray diffraction patterns) and macro-molecules and domains were re-arranged.

**Such** considerations assume increased significance when we go to the finer wires. Whereas the soft annealed wire of comparatively larger diameter has to be handled at a lower tension per unit of crossection, such proper working tensions on that particular wire can be safely increased as it is gradually drawn and redrawn through successive sizes, with intermediate strain-equalizing stages. The processing has a tendency to align the substructure and thus increase the range of safe tensile characteristics.

* * *

**In** the instance of copper wire this means that a copper wire of small diameter exceeding in fineness #40 AWG (finer than .0031″) may have an ultimate tensile strength in the vicinity of 60,000 lbs/ square inch. In comparison, the #18 wire with a diameter of .0403″, as discussed in the load-elongation diagram of Figure 3, has an ultimate breaking strength in terms of the 1″ bar, perhaps, of only 30,000 to 35,000 lbs./inch.

* * *

It should be realized that a wire while being drawn is subject to cold forming and stress hardening. The percentage of the amount in tension as well as compression with which the mechanical properties of a wire are changed during repeated drawing, annealing and other wire preparatory operations changes with the case history of the wire. It must be understood furthermore that a material that is drawn through a die whereby its crossectional area is reduced, is subjected not only to the forces of longitudinal tension but also to those of lateral compression. Pulling a bar through a die subjects it to compression in the direction of its crossection. **Tension is relief of this internal compression.** The reduction in crossectional area enhances its tensional characteristics, an important factor when comparing equal areas of crossection whereby one is achieved during passage in the reducing die whereas the other is produced in a testing machine by what is to be a slow, uniform, longitudinal stretching process of a free wire pulled on its ends only in open air.

* * *

**The** type of surface the drawing die represents and its smoothness as well as crossectional shape also influence its subsequent performance. If there are areas in the die which due to roughness or other deviations from standard shape, cause more yielding of the wire in that particular area of contact, then the wire has been deformed there more than over the rest of the material. It then has greater sensitivity to chemical attack and other factors that influence corrosion at the entering wedge which the micro-cracks present. Thus **from the viewpoint of wire performance uniformity of tension during processing is important. The tensional gradients set up should be uniform across the entire crossection of the wire.**

* * *

**We** are dealing then not only with a condition whereby Poisson's ratio shifts, but also where due to repeated cold forming and equivalent processes, slippage occurs and a relocation of the microcrystalline structure takes place as indicated in the dislocation theory of metals.

* * *

**Not** all of the deformative forces are shown in changes of material. Some of them are retained and constitute then permanent strains that are set up within the material, unless they are removed by annealing and similar methods of equalizing. We are dealing not with one single phenomenon but with a combination of several which range from the locked-up stress within the wire during processing to the plastic flow and permanent deformation which results in what is commonly regarded as reduction of crossectional area.

* * *

**Into** this field belong also questions of metal fatigue. From this viewpoint it is significant that isoelastic materials are known to have excellent fatigue resistance. It is interesting that these are to some extent metallurgically related to the Ni-Span "C" type wires which are also known to have **good fatigue resisting properties together with good thermo-elastic compensation.**

* * *

**Special** attention should be given in connection with this to the surface conditions and the uniformity of the interface between wire, guide, capstan and other contacting elements. It is known already from working with steel that even minor cracks such as shown by methods of magnetic powder applications constitute an entering wedge for damage of more severe nature. Being non-magnetic and requiring essentially larger pieces of material, this method as such is not directly applicable to copper wires. However with certain modifications the principle can be used.

* * *

**In** connection with die as well as wire-surfaces, electro-mechanical polishing should be given serious consideration. Already the Soviet Union has methods for electro-mechanical polishing and also for giving materials satin surfaces whereby simultaneously an improvement of the work piece takes place. While no production data are available, it is known that the Soviet methods concern themselves with electric current at low voltages. The rotating material is polished down with a smooth polishing tool. It seems that the electric current softens up the surface irregularities which thereby are smoothened out. This improves the surface quality. It appears furthermore that the surface layers are changed metallurgically whereby an improvement in the microstructure of the material occurs. **Electro-mechanically polished materials have higher abrasion resistance as compared to the same materials which were polished mechanically.** Moreover, the hardness of the polished surface layers was improved above the originating materials several times.

* * *

**These** principles are of far-reaching significance. Their application to methods of improving the surfaces of conductive wires that are exposed to electro-mechanical stresses offers fascinating possibilities. For instance, **improvements in tensile strength and corrosion resistance may increase the free length with which a conductor can be suspended between poles** of a power or telephone line. Also increase of the safe tension with which it is permissible to wind a fine wire around a mandrel may possibly be influenced by such a treatment, as well as the contacting surfaces exposed to a slide wire as is done in potentiometers.

## Safe Tensions and Wire Parameters

**Material,** after having been subjected to repeated drawings, has a better aligned microcrystalline structure and uniformity. This justifies basing the safe tensions for such repeatedly drawn wires on an increased tensile strength which in the case of certain copper wires is then in the vicinity of 65,000 lbs. per square inch.

* * *

**Since** diameters are directly related to the conductor sizes in terms of AWG wire sizes, a graph such as shown in the subsequent nomograph, Figure No. 4 establishes the relation of Safe Tensions, not only for the exact wire sizes, but also for such in-between sizes as may be used from time to time (particularly if the wire has been purposely "pulled down" to a finer size as is customary in certain production operations).

* * *

**Assuming** conservatively that the ultimate tensile strength (K) for the finer annealed copper wires is 60,000 psi *) we are within the limits of mechanical safety requirement if we specify that but a quarter of the ultimate modest tensile strength of 60,000 lbs, — to wit 15,000 lbs per square inch — should be used for these finer wires.

* * *

**In** contradiction to this are the wires that were not subjected to repeated drawings. Wires heavier than #25 AWG are not as yet in a state of alignment and uniformity in their micellar structure comparable to the finer wires. Their mutual internal cohesion is still influenced to some extent by the loosening up and sponge-like structure that annealing in hydrogen produces. Considerable metallurgical work shows that the heavier wires upon crossectioning show a somewhat discontinuous interior under the microscope. Therefore, unless the wires have been subjected to multiple drawing and

*) (General average of the values given in the Standard Handbook for Electrical Engineers, 6th edition).

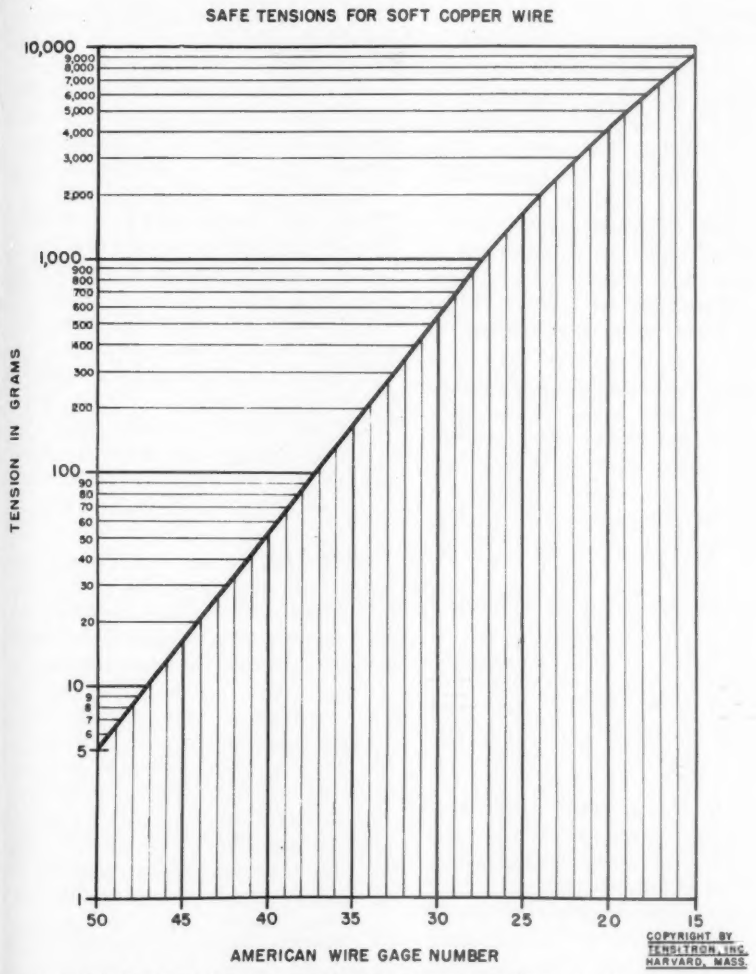



Fig. 4 — Safe Tensions (Grams vs. A.W.G.) for Soft Copper Wire. * * * * * * * *

thus cold-forming, only approximately ½ of the 15,000 lbs Safe Tension per square inch that are used for wires finer than #25 should be applied for the heavier wires. To be on the safe side, the heavier wires were calculated, therefore, for 7,500 lbs per square inch in the nomogram, Figure No. 4.

* * *

**Thus,** Safe Tensions (S.T.) as a function of the wire diameter (D) are in first approximation as follows:

$$S.T. = \frac{K\pi D^2}{4} \qquad (3)$$

* * *

**Herein** (K) is the safe tension per square inch of wire. It should be understood that (K) is not a constant. It changes not only for different materials but also for one and the same chemical analysis dependent on the number of drawings of a wire, its annealing schedule and the total case history of the wire as mentioned before.

## Nomogram for Safe Tensions vs. Wire Size (A.W.G.) Figure No. 4

**For** operation within safe tension it is important at all times to operate within their elastic limit. This in accordance with accepted good engineering practice may be defined in terms of properties of materials as the Working Stress or the Allowable Stress. It may be defined as the intensity of stress which the wire (or compound material respectively of wire and its insulating cover respectively) is adequate to resist.

* * *

**For** all practical purposes the processing should be kept within such parts of the stress-strain characteristics within which Hooke's law is valid.

**With** certain interesting exceptions Hooke's Law*) states that

$$\sigma = \frac{Pl}{AE} \qquad (4)$$

Hereby

**P — Force producing extension of wire**
**l — Length of wire**
**A — Crossectional area of wire**
**E — Elastic constant of wire or its modulus of elasticity**
**$\sigma$ — Total elongation of wire.**

* * *

**Within** the proportional limit it may be stated, therefore, that the elongation of a wire is proportional to the length of the specimen and the force acting on same. It is inversely proportionate to the crossectional area of the wire and its modulus of elasticity.

* * *

**Within** this region stress is essentially proportionate to strain. Upon release of the tension, the wire endeavors to return elastically to its original size without permanent deformation or lasting damage.**) (This, however, refers to winding or other processing on the **finished** wire. In wire **drawing,** tensions must exceed the elastic limit).

* * *

**It** is moreover assumed in this connection that the stress distribution is uniform throughout the material and that the potential energy of strain is a direct function of the work done and also that it is permissible to neglect the small temperature changes which accompany as a rule elastic and partially elastic deformation.

* * *

**When** dealing with wires of greater crossection, physical material uniformity does not exist to that extent. Also, in these larger diameter wires the multiple drafting which underlies uniformity of structure and swaging in other types of wire, has **not** taken place. Accordingly, we deal with materials the structural constitution of which is not the same. Therefore,

*) Robert Hooke. De Potentia Restitutiva, London, 1678.

**) This condition is idealized. A perfectly elastic body exists in theory only, that is to say a material which recovers its initial shape 100% after unloading. As a rule mechanical hysteresis does exist, though to a very small extent only if the experimental conditions are chosen with care. For all other instances the material must be considered partially elastic only; that is to say that its deformation disappears in part only upon removal of the load.

the safety factors which will be found correct for the finer copper wires should be handled with care when dealing with materials of greater crossection and different hardness, alloys, etc.

* * *

**According** to trade practice, copper wires fall essentially in 3 categories of physical description which are commercially defined as follows:

1. **Dead soft.**
2. **Full hard.**
3. **Full soft.**

* * *

**It** will be seen from the above that a table of Safe Tensions which is reasonably accurate for the finer wires can at best be only a start in the right direction as far as the wires of larger diameters are concerned, or that have different alloying and material structures. An understanding of the true causes of the strength of a wire and the stresses to which it is subjected under different production conditions is needed. No broad generalization should be made, therefore, for wires of larger diameters that have been subjected to annealing, that are laid around mandrels of rectangular crossection, or are subject to such other production conditions that may interfere with the linear law. This latter applies to the finer wire sizes only.

* * *

**In** copper clad steel, copper weld, etc. we are not dealing any longer with pure copper (soft) as such, but with combinations and alloys which can be anything from steel to copper, silicon, manganese, copper-chromium alloys, copper-beryllium and copper-zinc-cadmium alloys. In all these a compromise has to be reached between electrical conductivity and the mechanical characteristics of the wire. For details of these factors reference is made to tables of comparative properties of certain copper alloy wires which are available from the several wire and cable manufacturers.

* * *

**Thus,** from a practical viewpoint of safe tensions of copper wire we can assume that they are reasonably linear only in such parts of the safe tension characteristics where a case-history of considerable structural alignment by many drawings has occurred.

* * *

**Whereas** we have considered in the above primarily conductors of excellent **conductivity** such as copper, this condition is aggravated when we are dealing with materials the uniform electrical **resistivity** of which is of importance, for instance, in the making of precise potentiometers and other wire-wound resistance devices.

* * *

**When** we consider nichrome or other resistance wires, it is axiomatic that we would then have to refer to their equivalent pounds-per-square-inch safe operating tension, substituting same for the tensile characteristics of copper.

* * *

**Here** the tension with which the wire is de-reeled and thereafter applied to the mandrel, influences the linearity and other electrical requirements of precise slide-wire or rotary contact resistance devices.

* * *

**Last** but not least, excessive tensions on tungsten wires and other materials used for incandescent coils or heater elements may produce local necking-down of the wire which results in "hot spots", causing pre-mature burn-out in the place of excessive current density.

* * *

**Thus,** the measurement first and control thereafter of wire tensions is of significance throughout all wire preparatory processes. It is particularly critical for the finer wire sizes. It influences the entire history of the wire, beginning with drawing, tinning, enameling and insulating, and its subsequent coiling and winding operations.

* * *

**From** the viewpoint of standard wire winding operations we want to be sure at all times, that the wire is laid down with a tension significantly below its yield strength and well within its practical elastic limits.*) This will then take up in a non-destructive manner minor deformations that might have been applied due to such unavoidable remaining **shock-loading** as occurs during normal handling.

* * *

**At** no time should we approach the danger limit of the ultimate tensile strength of a wire. The penalty for such excessive tension is lack of uniformity, both of electrical and mechanical characteristics of the coil, reduced resistance to insulation breakdown where the insulating cover was "crazed" (fracture-crevices in the insulation similar to those shown in Figure No. 2) and "hot spots" where the wire's crossection had been narrowed down excessively over the adjoining wire-lengths thus producing excessive current densities of the wire at that spot.

* * *

**Notwithstanding** deviations for non-round mandrels, for the heavier wires, etc., what matters is that from approximately #25 AWG and finer the linear relation is essentially correct. It is of value in the winding of the coils where the finer wires are used and the tension then becomes critical because even a few grams of tension variation constitutes a significant percentage of the total Safe Tension. Hence **precise control of tension becomes the more important the higher the wire number is** (and thus the smaller the wire diameter and the allowable stress to which it can be exposed).

* * *

**Not** only is the Safe Tension per unit crossection more critical in the use of the heavier wires. This condition is made even more severe due to the particular trade practices of converting semi-processed wires.

* * *

**It** is desirable then to hold means of control to approximately within a tolerance of plus or minus 1 lb, when dealing with the heavier wires. This range is necessary due to the eccentricity of, and poor winding on some supplier's spools.

* * *

**The** increase in wire tension experienced when the wire is wound off the supplier's spool in some instances goes beyond proper engineering tolerances.

* * *

**A** secondary necessity for close control at this point is that it is at

*) **For details of analysis and definitions regarding the strength of materials, reference is made to Timoshenko (18).**

times customary practice to "pull down" wire from suppliers standard dimensions to fit users particular applications.

* * *

**Thus,** from the crystal size and the comparative loosening of the intermetallic bond within the core of an annealed wire to its crystal composition, micellar structure and the absorption of hydrogen due to annealing, there are many factors that influence the hardness of copper, its tensile strength and its Safe Tension. We are dealing with a material of essentially uniform **chemical** nature only. However, its changes in **physical** characteristics are such that we must reduce the permissible maximum Safe Tensions as we go towards greater wire diameters. **The microstructure of the wire changes with its diameter and the number and case history of cold forming processes to which it was subjected.**

## Microstructural Considerations

By the very nature of the deepening understanding of tensional characteristics, the limitations should be realized that this method imposes.

* * *

**Production** methods must by necessity be based upon the average behavior of a large number of individual events. They can then be integrated into the function of, say for instance, the systematic stretch and improvement in microcrystalline parallelism of a wire as it passes one capstan after the other and the drawing dies in between. Industrial performance is ultimately based upon the summation of single events in the fine structure of the individual micromolecular components of the wire.

* * *

**Change** in physical structure is marked at all times by an incipient starting point. Local deformation and stretch starts with individual dislocations and movements within the magnitude of the metal crystals themselves. Such incipient motion can be observed with an electron microscope and by photoelastic analysis practically at the origin of the load-extension curve. Actually **the yield strength of a wire is a statistical concept only.** The material of which a wire is composed is heterogenous and **not** homogenous. Slippage between individual grains starts early. The so-called yield point is just the condition where the probability of slippage is increased.

* * *

**We** are dealing in toto only with the behavior of masses of wire that act as though they were operating under conditions that may be represented by the analogon that the statistical approach offers. We do not understand fully, however, the true individual physical happenings (and therefore make no major improvements and inventions) till we recognize the factual meaning of the single event in all its criticality. Before we can go much further, a deepening of our knowledge is required of what holds matter together. Only then can we start to develop materials and methods in a direction that will produce greater cohesion between grain boundaries and reduce inter-metallic dislocations and slippage to their unavoidable minimum.

* * *

**We** are at the point of technology where further improvements in wires must be based upon the phenomena that occur at the level of the basic structure of the material under investigation. Thus the role of solid state physics is of major importance in improving the understanding of existing materials — and in raising their material parameters to comply with the increased performance demands of this age of space technology, electronics and nuclear advance.

* * *

**As** we gradually progress from what was first the art more than the science of wire technology, as a logical system of systematic quantitative recognition is introduced instead of repetition of action based upon empirical knowledge of results obtained when certain steps are taken, chemical technology grows to the point where it gives valuable assistance to the practical limitations posed by unrelated empiricism only. Yet as chemical technology (in a general manner) is taken over by the quantitative science of metallurgy, we find ourselves confronted with the increased performance requirements demanded by the missile, the jet engine, the micro-miniature ultra-high-frequency circuits, the gas turbine and nuclear propulsion systems — to mention but a few of the new requirements that this second half of the 20th century posits. In the copper itself as well as in the tin, zinc and other materials that cover the copper core, changes are initiated under stress. This basis for the deformation of the material may be found in its fundamental structure. 3), 4), 8), 14), 15), 16)

* * *

**With** critical conditions reached in many instances, further improvements require advance of our fundamental knowledge of the properties of matter. From resistance to fatigue within the structure of a sonically vibrated element of construction (16, 17,) to the yield strength of cables exposed to nuclear radiation for a prolonged time, and from the stresses on guidance cables in missiles to supersonic aircraft we are dealing with a host of new requirements where resistance to failure is vital for the end-use of the materials thus employed.

* * *

**Whereas** in the instance of the manufacture of wire and wire-wound materials the methods of quality control by applied statistics are as valuable as they are necessary, it should be realized that this method of investigation is geared in this particular instance to the maintenance of the status quo. If we are to make real progress, it is necessary to transcend a system of mutually benefitting superficial improvements in hardware. What is needed is a deeper understanding of the individual elements that constitute a wire, and their relative inter-action in the event of total or partial failure under the different forms of stress to which they are exposed.

* * *

**By** investigating the lesser known properties of materials such as the boundary conditions between the grains that constitute the inside structure of an alloy, by the observation of individual dislocations and their motion in

and between the micro-crystals and their complicated relation of mutual bondage, by getting a working theory of "lesser" known side effects such as the strange phenomenon of acoustic emission when a wire is stressed (13-17) we may indicate some of the inroads that can perhaps be followed for a better understanding of the phenomena as they occur at the basic structural level. This constitutes lateron the material with which we are working. X-ray diffraction patterns, while constituting a statistical effect to some extent, are valuable in bringing about greater clarity of changes in the substructure under stress.

* * *

**Such** apparently simple statements as a load-extension curve are nothing but the integration of the plurality of individual phenomena that constitute the grain movement, energy exchange and the bonding system at the submicroscopic level. While utilizing the engineering approach that the standard methods of physical testing and chemical analysis offer, we must not loose sight of the fact that dislocation behavior and events that occur at the grain boundaries of the polycrystalline materials — to mention but a few possibilities out of a much larger multitude — are based ultimately on the strain occurring at the microstructural level. A truly fundamental study of the behavior of materials when same are exposed to vibratory stresses (whether mechanical, acoustic or magnetic to mention but a few) must be based upon the deeper understanding of the individual events that underlie elasto-plastic deformation. Only in their apparent totality they constitute the macro-phenomena. If real basic progress is to be made, our perspective must include the vast possibilities that applications of the science of solid state physics offers in our field. The deepening of understanding as to the true nature of causation in the field of micro-metallurgy may pave the way for important technological advances, such as stronger wires, controlled electric conductivity, and faster production methods.

* * *

## Tension of Moving Wires

**It** is important to call, in this connection, the attention of the serious investigator not only to the inside crystallographic structure, but also to the deviations from the roundness of the wire diameter and the variations from smooth tensioning and uniform crossection of the conductors produced thereby.

* * *

**Surface** imperfections vary from wire to wire and from die to die. Deviations from the average mean can be noted in terms of such surface imperfections as will offer an entering wedge for subsequent damage during the stresses of modern high-speed processing.

* * *

**It** should be realized that we not simply double the stress when the speed is doubled. The mass m per unit crossection of the wire subjected to a change of speed in the amount v, incurs a change in kinetic energy of $\frac{m \triangle v^2}{2}$. Hence changes in speed that seem to be but minor in the absolute system, influence the physical nature of the process according to a **square** law. Dangerous conditions may therefore occur when the mass of a wire moves under the high-speed conditions demanded by efficient production.

* * *

**Particularly** in such instances where frictional tensioning devices are used on the wire, lack of surface uniformity shows a corresponding change in the detent of a frictional tensioning device in contact with the wire not linearly but in accordance with an exponential function of involved nature.

* * *

**This** refers not only to the physical distribution of the metallic copper as such, but also to contaminations of the surface, for instance, in terms of inclusions of oxides and impurities. It is of at least equal importance in wires covered with insulation where the stick-and-slip character of surface friction may be found emphasized at times even more.

* * *

**In** view of the importance of actually knowing by objective instrumentation in a quantitative manner such critical tensions, "feeling" tension of a wire that travels at high speed by hand is as antiquated as using the human foot as a measure of length instead of a scale.

* * *

**In** view of this condition of kinetic energy transfer and the sudden shocks to which a wire is exposed while rapidly moving in accordance with the high production conditions required by effective plant operation, it is not necessarily correct engineering to transfer an apparently safe operating tension as determined under the quasi-stationary conditions of the laboratory to the dynamic conditions of industrial production. The tension changes to which a wire is subjected when travelling through dies or over mechanical tensioning influences its structure differently as compared to the slow and steady forming when it is gradually and slowly stretched on a tensile strength tester.

* * *

**We** can measure now, however, by quantitative instrumentation at which tensions a moving wire can be handled effectively. Lacking the fundament of a truly comprehensive theory, **the performance condition of a given position may be assumed to be correct if it behaves for a prolonged time adequately under the conditions of that specific setting.** The problem is then to transfer this condition of which an engineer justly can approve to the other production positions which exert an equivalent stress upon the wire. Thus, means for comparing objectively indicated tension at each position are necessary for the practical millman. He has to **transfer the tensions known to produce best to all his other individual units and settings.** Better quality and more economical, safer operation results from this.

* * *

**For** comparing such tensions and their variations during actual dynamic wire-winding or processing operations, an instrument was developed, therefore, which is shown in Figure No. 5. This Tension Meter is essentially

Fig. 5 — Trigger Tension Meter. Courtesy, Tensitron, Harvard, Mass. * * * * *

a three roller device in which the two outer rollers furnish the reference position for the wire and the center roller acts as a sensing element that is deflected against the restraint of a reliable beryllium copper spring. From the viewpoint of physical instrumentation the 3-roller system constitutes a mechanical shunt. This makes possible to deflect the center roller but little (which avoids major bending which would distort the wire). In order to make this small motion visible, a gear-train is used. This furnishes adequate mechanical amplification for showing clearly the deflection of the indicating pointer on the dial facing the operator.

### Trigger Tension Meter Figure No. 5

An automatic inserting mechanism is used whereby the two outer rollers are lowered simultaneously when the trigger of the mounting plate is depressed (in the same manner in which a gun is cocked). With the rollers thus opened wide for wire insertion, the wire — even when in full motion — is held against the mounting plate and placed automatically upon the two outer rollers. Releasing the trigger gently, the wire drops into test position between the V-grooves of the pulleys. The ball bearing rollers are recessed into the supporting surface of the guiding shield. Thus, the wire cannot get caught in the back of the ball bearing rollers . . . an important detail when dealing with wires travelling as fast as 10,000 feet per minute and with the probability of production speeds increased even more.

### A Simple, Qualitative Test For Yield Strength

For doing this, the fine wire is held by a binding post or equivalent on one end. (See Figure No. 6). The other end is pulled (at least for the thinner sizes) by hand while a Tension Meter is inserted into the wire thus stretched.

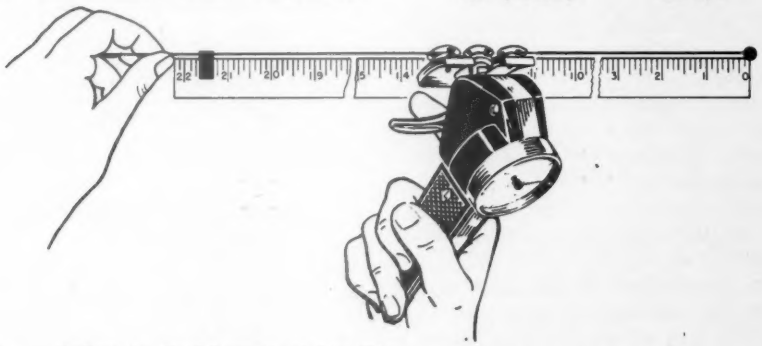


Fig. 6 — Feeling the Yield Strength of Fine Wire. * * * * * * * * * * * * * *

Then, by slowly moving the hand that holds the wire away from the fixed wire-end, the tension on the wire as read on the Tension Meter can be seen to increase gradually. It can be "felt" when the wire finally starts to yield, that is to say, when no increase in tension is shown on the dial indicator despite the fact that the wire is extended still further.

* * *

After the yield point, the readings on the Tension Meter remain essentially the same while the length of the wire increases. This indicates deformative processes and permanent wire damage. **When winding wires into coils or for potentiometers, the wire must not be stretched at any time past this danger point where one can feel that the finer wires start to "flow".**

* * *

By pulling the wire along a graduated measuring tape or its equivalent, it can be seen by the gradual elongation of the wire how the load as indicated by the readings on the dial of the Tension Meter compares with the extension that is shown on the yardstick. Thus, in a simple manner we can tabulate for each load shown on the Tension Meter the length as read on the yardstick or equivalent. (Table No. 7).

Table No. 7

| *Tension in Grams Measured on the Tension Meter* | | *Length of Wire In Inches* |
|---|---|---|
| 0 | | 20 |
| 30 | | 20 1/16 |
| 35 | | 20 1/8 |
| 40 | start of yielding | 20 1/4 |
| 40 | | 20 1/2 |
| 40 | | 20 5/8 |
| 40 | | 20 3/4 |
| 43 | | 21 |
| 45 | | 22 |
| 45 | (break) | 22 3/8 |

While the above should not be construed as a standard test method (since the speed of the hand is not evenly controlled and the pulling-speed influences the ultimate breaking strength) we do have here a method to estimate with an accuracy that is sufficient for many practical purposes the tensional characteristics of a fine wire. It is particularly important that this method gives an **indication of the load above which injury takes place in fine wires.**

* * *

The above figures were determined for fine enameled copper wire. The average of 5 readings of its diameter taken before stretch was .0038" which is the equivalent of approximately AWG #38. Upon conclusion of the test, the diameter of the wire was again measured. After exposure to the ultimate breaking tension, the wire diameter, again as measured as the average of 5 determinations, had been reduced to a permanent .0030".

This is the approximate equivalent of AWG 41½.

* * *

**That** is to say, the wire was not only elongated from 20 to 22 inches in length, but **at the same time its crossection and thus its total strength and current carrying capacity were impaired.** Such narrower crossections of the conductor may produce of course over-heating, change the magnetic domains, create strains within the structure and cause other side-effects not readily discernible with the naked eye or devices sensitive to surface conditions only.

* * *

**It** is interesting to note that the yielding of the wire started in the vicinity of 40 grams in this instance. Despite the fact that the final break did not occur until 45 grams, yielding and thus permanent set entered **below** the ultimate tensile strength. Thus, in order to be on the safe side during coil winding or similar wire preparatory operations, **it is imperative that the tensions be kept well below the load where the wire "flows" during its actual processing.** It is not enough to check the tension while the spool is essentially static. Hence objective tension indication first and tension control thereafter as the sum of all the varying tensions seems logical for good engineering. Methods of tension compensation can then be taken that will deliver the wire to the coil about to be wound under uniformly proper winding conditions, avoiding over-stretching, deformation, "crazing" of the insulation, permanent narrowing of the wire crossection and misalignment of the micellar structure.

* * *

**Constructions** of the type shown have been used successfully for wire sizes from #30 to #50 AWG. However, heavier equipment is required, as a rule, for checking tensions on wire sizes larger than AWG #30. (Soft copper wires which stretch excessively at tensions less than 4 lbs. are an exception. For such sensitive wires the 2,000 gram trigger meters should be used). Thus, for sizes between approximately #15 and #27, a new Lever-type Tension Meter was designed. It is shown in the subsequent picture No. 8.

Fig. 8—Lever Tension Meter for the Higher Tensions. Courtesy Tensitron, Harvard, Mass.

### Lever Tension Meter Figure No. 8

**This** heavier, lever type meter can be constructed in ranges up to many pounds. The particular instrument shown has a range of 50 lbs. The three roller shunt was used again because it makes the Tension Meter essentially independent with respect to the direction in which the wires run. In view of the larger forces employed, however, an inserting mechanism is used which lowers the two outer reference rollers simultaneously by the use of a compound-action lever instead of the trigger operated mechanism shown previously. In such heavier wires their stiffness and diameter are not negligible any longer and compensation has to be made for them.

* * *

**Such** heavier meters are used for checking tension during insulating and tinning of wires and also during certain wire-drawing operations.

### Tension in Non-Round Coils

**In** winding rotors for fractional horsepower motors with wires of on or about #27 AWG, it is helpful to check and control the dynamic tensions encountered particularly in covering a non-round cavity or rotor.

* * *

**Whereas** in a round coil there is a uniform winding speed for each layer of wire when the mandrel is rotated, acceleration and deceleration enter when depositing wires upon mandrels of square crossection or upon cores of non-round shape. Tension is then not equal any longer to the diameter only. As can be seen from the next picture No. 9, the speed of the wire is highest when the wire is laid on a mandrel of square crossection in such spaces where it is nearest to the axis of rotation.

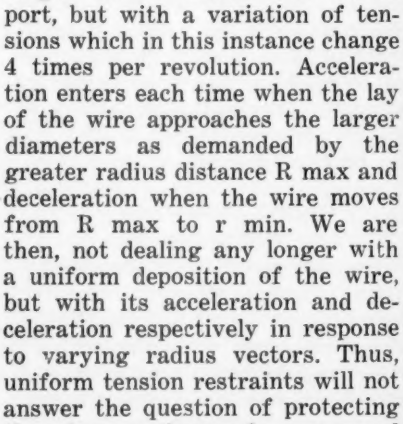



Fig. 9—Speed of Wire Changes with Distance from Rotary Center of Non-Round Coil-Form.

**We** are, then, not dealing any longer with uniform wire transport, but with a variation of tensions which in this instance change 4 times per revolution. Acceleration enters each time when the lay of the wire approaches the larger diameters as demanded by the greater radius distance R max and deceleration when the wire moves from R max to r min. We are then, not dealing any longer with a uniform deposition of the wire, but with its acceleration and deceleration respectively in response to varying radius vectors. Thus, uniform tension restraints will not answer the question of protecting the wires any longer for non-round coils.

* * *

**Variable** tensions have to be used instead. A number of methods are in use to compensate for this change of winding speed and thus tension. On smaller wires, dancer arms are frequently used

(*Please turn to page* 1664)

# Bonding Characteristics of Insulating Varnish and Wire Enamel Systems

by
**Donald L. McClenahan**
**Schenectady Varnish Company, Inc.**
Schenectady, New York

This paper was presented at the Annual Convention of The Wire Association October 13, 1959, at Cleveland, Ohio.

The author, a native of Ogden, Utah, graduated from the U. S. Naval Academy in 1943 and served as a gunnery officer aboard the USS Marblehead during the last war. When the smoke cleared away, he was employed by Sperry Gyroscope Company as a technical representative and later he went with the General Electric Company in Schenectady in their Electronic Control Engineering Division. He joined his present company in 1948 as a technical representative, a position he held until 1956, when he was made Chief Electrical Engineer in the firm's newly organized Electrical Testing and Development Laboratory. He is a member of ASTM and AIEE and is Chairman of the latter's working group on varnishes of Subcommittee on Thermal Evaluations, Committee on Electrical Insulation.

**Motors,** generators, transformers and similar electromagnetic devices are all subject to electrical, mechanical and thermal stresses which cause movement and failure of coils if not held rigidly. In some designs, tie cords, banding and similar methods are used to hold magnet wire coils in place. In the greatest number of cases, however, it is the insulating varnish alone which bonds and holds the coils in place, preventing movement and failure of the equipment. Therefore, it is extremely important for the design engineer to be certain that the varnish being used will do the job for his particular machine. To a large degree, application will dictate the type of varnish needed. For example, large coils of a motor stator or coils of a transformer require a pliable, tough varnish which will allow the coils a small degree of movement or flexibility without cracking or losing adhesion.

* * *

**On** the other hand, a high-speed wound rotor which is acted upon by severe centrifugal stresses must have a hard, almost brittle varnish to hold its coils in place when running at high temperature under full load.

* * *

**How** then can the insulation engineer know that the varnish he plans to use will have the holding power needed for each application? Winding a large expensive machine and experimenting by trial and error is obviously not the answer. There must be some way of telling from laboratory tests which varnish should be used — but which test method will do this? The test, of course, should be simple, inexpensive and the results obtained should be reproducible. Over the years, a number of methods have been devised and used:

1. Splints made of short lengths of magnet wire, bonded with varnish, have been tried. The force required to pull the center wire from the splint will show the bond strength of the varnish to the magnet wire.
2. A similar test specimen for the Bundle Bonding Test consists of a number of short lengths of wire bundled around a center wire. This specimen is dipped in insulating varnish and cured. The force in pounds to pull the center wire from the bundle gives higher values than the splint test and is a good measure of bonding strength. (See Fig. 1)

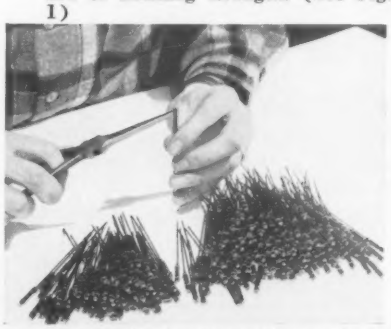


Fig. 1 — Preparing bundle bonding specimens.

3. One manufacturer devised a test in which a brass screwhead is bonded to a metal plate by varnish. The force necessary to knock the screw over is used as a gauge of bonding strength.
4. Another test is made by varnish-treating a spring-like coil of wire called a helical coil. By measuring force to break the coil, the strength of the bond is determined.

Of all these tests, the Helical Coil Bonding Test has gained the widest acceptance and seems to represent more closely the bonding of insulating varnish in electrical equipment. This is especially true of rotating machines. The Helical Coil Bonding Test is sometimes called the "Dow Corning Bonding Test" because it was **J. F. Dexter** of Dow Corning who described this in Insulation magazine in September, 1955.

* * *

As the prime function of an insulating varnish (especially in rotating equipment) is to hold the coils together, the helical coil test is devised to measure this holding or bonding property. In its basic form, this test is:

1. Wind a coil of magnet wire on a mandrel; (See Fig. 2)

Fig. 2 — Winding helical coils on a 1/4 in. mandrel.

2. Treat the coil with an insulating varnish; (See Fig. 3)
3. Then break it in the transverse direction and measure how many pounds are required to do this. (See Fig. 4)

* * *

Most laboratories use 18 AWG wire for the coil, although this is

Fig. 3 — Helical coils are dipped in insulating varnish. * * * * * * * * *

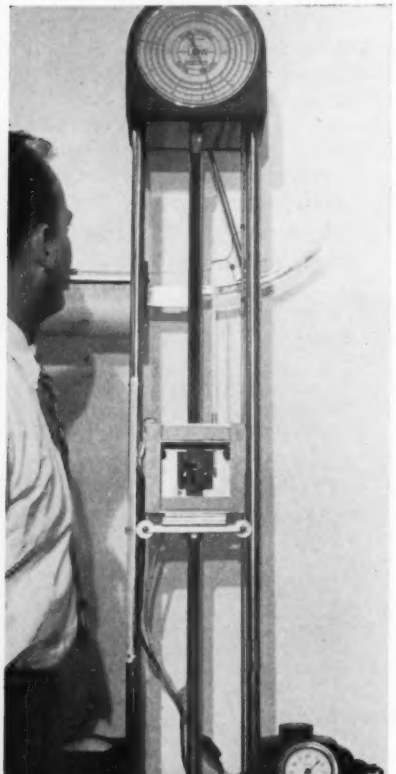



Fig. 4 — Bonding strength of a varnish-treated helical coil is measured in the test fixture of a tensile machine. * * * *

not standard. Wire sizes from 15 to 20 AWG can be used satisfactorily. Coils may be wound either by hand or by mechanical means on a ¼-inch mandrel. A fairly constant tension should be kept on the wire, and it is important to wind one loop of the coil tightly against the next without "skips".

* * *

**Coils** approximately 3 inches in length are dipped in insulating varnish and cured in a baking oven. Our laboratory has used 6-inch coils to facilitate dipping and to coat more coils in a single operation. These are later cut into 3-inch lengths. It is most important to adjust the varnishes by thinning to obtain a build of 1-millimeter per dip. This is done by standard ASTM methods, using copper strips. Having all varnishes in a test so adjusted will tend to produce greater reliability and will minimize erratic results. For example, varnishes which are extremely high in viscosity or solids may produce heavier coats, and work to the advantage or disadvantage of a particular varnish. Adjusting to a uniform film thickness puts all varnishes on a common footing.

* * *

**The** coils are usually given two varnish applications, reversing direction between dips. This will give a uniform build along the full length of the coil. In some cases, however, the bonding strength with one dip may be of interest.

* * *

**The** important thing to remember is to eliminate as many errors as possible by treating all materials in a particular test alike, thus attaining reproducible results. For example, dipping should be done under standard temperature conditions. Coils are withdrawn from the varnish at a uniform rate. A practically universal method in varnish laboratories is to use a Fisher-Payne Dip Coater, removing specimens at a rate of 4 inches per minute.

* * *

**Coils** in an individual test should be cured in the same oven simultaneously. The bake cycle (temperature and time) should be carefully controlled.

* * *

**Coils** are now ready for test. These are broken in a transverse fixture having a dimension of 1¾ inches between outside anvils. The center anvil is adjusted as close to the middle as possible. (See Fig. 5) Tensile machines having a uniform rate of drive are helpful. We have found that approximately 3 inches per minute produces good results.

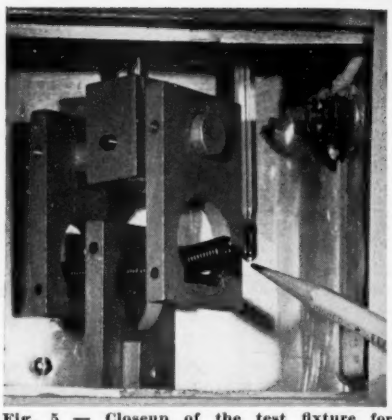


Fig. 5 — Closeup of the test fixture for breaking helical coils. * * * * *

* * *

**Provision** should be made to test coils at elevated temperatures. As motors and transformers get hot, it is important that the varnish hold the coil under these conditions. We must, therefore, know how the varnish will bond at 100, 130, 180 C. or higher. The small oven around the test fixture will permit the tester to get this data. (See Fig. 6)

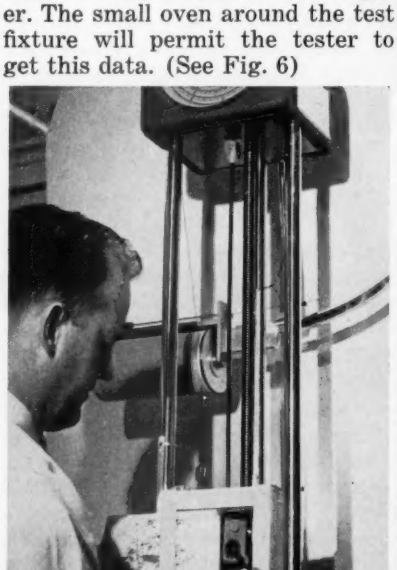


Fig. 6 — A small oven around test fixture permits obtaining data at elevated temperatures.

**Let** us look for a moment at the data one can obtain by this method:

* * *

**Figure 7** is a graph of bonding

(*Please turn to page* 1672)

# The Manufacture of Wire Products--Oven Racks, Baskets and Refrigerator Shelves

by F. B. Thacker
The Bauer Brothers Company
Springfield, Ohio

This paper was presented at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 12, 1959.

It is indeed a pleasure to have the opportunity of addressing the Annual Covention of The Wire Association on the subject of the manufacturing of Oven Racks, Baskets, and Refrigerator Shelves.

* * *

Our company has been manufacturing wire products since 1947, and our activities have been confined strictly to contract work for the major appliance manufacturers. Our customers include: Frigidaire, a Division of The General Motors Corporation; The General Electric Company; Westinghouse Electric Corporation; The Tappan Stove Company and The Philco Corporation.

* * *

It is true that we have confined ourselves to high production work and in the course of any single year we produce as much as 300,000 to 400,000 pieces of a single item, however, we are not able to produce any one item on a long production run. We are indeed very fortunate if we are able to produce any one item in lots of 25,000 to 30,000 pieces. Consequently, our equipment has to be extremely versatile in that we must be able to tear down and set up in a very short period of time. You might say that our plant is, for all effective purposes, a large job shop operation.

* * *

As all of you probably know, the appliance industry, with particular reference to refrigerators and gas and electric ranges has for the past few years been very much depressed, particularly from a profit standpoint and therefore we find that being a supplier requires extremely low pricing, and profits are only gained by a constant invention of new and better methods of fabricating and finishing wire products.

* * *

I am going to attempt to describe the fabrication of Oven Racks, Baskets and Refrigerator Shelving to you by means of photographs which have been taken from time to time in our plant. It is unfortunate that we were unable to obtain the photographs that we would like to have had but our plant has been on strike since August 1, and consequently some of the photographs are not as good as we would like them to be.

## Wire Shelving—Oven Racks and Refrigerator Shelves

(Figure No. 1 — Wire Straightener) From the picture you can see that we use the conventional methods of wire straightening in order to obtain frame wires or fill wires for wire shelves. This, of course, would also apply to production of items such as baskets.

Fig. 1

* * *

(Figure No. 2 — Frame Bender)

Fig. 2

We have found from experience that there is very little wire fabricating equipment on the market today. As an example, we have never been able to find an effective machine to form frames of various sizes. This machine was designed and built at our plant. In the background you can see the operator is loading the straightened and cut wire into a hopper type feeder. The wire is fed by a belt into the frame bender where the two outside bends are first made and then the two inside bends are made. After bending is completed the formed frame is then dropped off into a catcher located in the center of the picture. This type forming enables us to hold very close tolerances which are required for shelves, particularly in reference to refrigerator requirements. To a frame we now attach the fill wires by means of resistance welding. No doubt, all of you are quite familiar with the method of applying the fill wires using a conventional Press Welder.

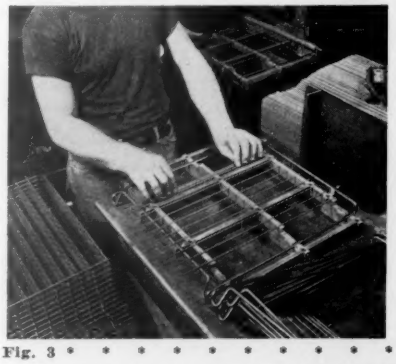


Fig. 3

(Figure No. 3) — Fill wires are hand loaded into a fixture and then welded at each wire intersection.

* * *

(Figure No. 4) — The conventional method of welding by means of a Precision type welder is far too slow for us to be competitive and consequently we designed and built in our plant, an automatic welding machine which is com-

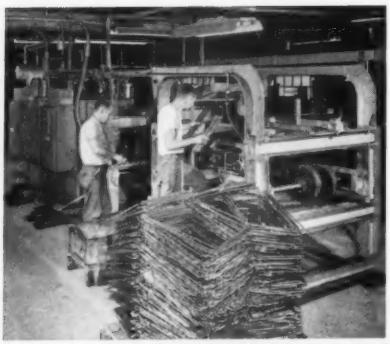


Fig. 4

monly called The "Flying Dutchman". In this photograph you can see the back end of this machine where completed frames are loaded into a hopper and are automatically dropped onto a chain which carries the frame underneath an automatic feeder (Figure No. 5) for

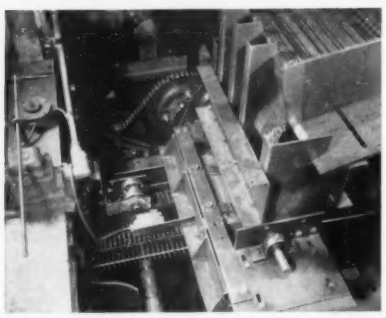


Fig. 5

the crosswires and then through welders and trimmers to complete the welding cycle.

* * *

**(Figure No. 6)** — It might be

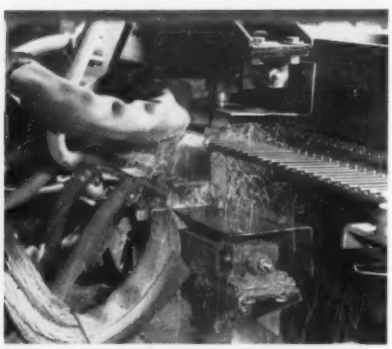


Fig. 6

well to note that the welders on this machine are equipped with floating electrodes which were designed and built by The Bauer Bros. Company. The common method of welding on any automatic machine has been by the index method but on our machine the movement of the work is continuous and the electrodes do the indexing. This enables us to produce on our "Flying Dutchman" at a rate of 425 pieces per hour.

* * *

**(Figure No. 7)** — This shows the completed shelf coming out the end of the machine.

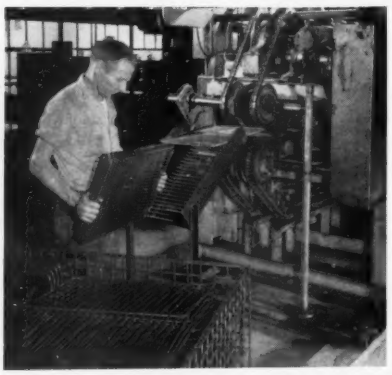


Fig. 7

**(Figure No. 8)** — Quite a num-

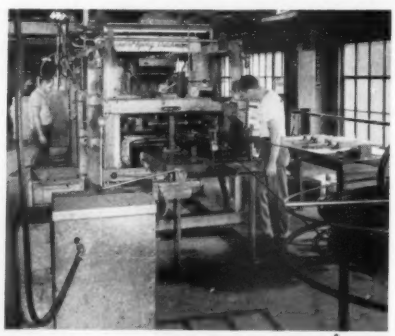


Fig. 8

ber of refrigerator shelves are made with a front rail and a back rail rather than a complete frame. When this type of design is required we are able to produce with one of our "Flying Dutchman" Welders at a very economical rate. The front and back rails are fed direct from coils. The straightening is done by rollers mounted at the back of the machine. The fill wires are hopper fed and again the floating electrode type welder is used and the trimming is done automatically.

* * *

**(Figure No. 9)** — This is a photograph showing the shelving coming out of The "Flying Dutchman" Welder on a continuous basis. To obtain the proper width of the shelf we have a flying cutoff which cuts both the front and back rail

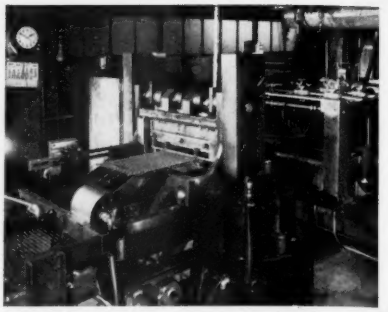


Fig. 9

of the shelf. This type of machine enables us to produce at an economical rate of 500 pieces per hour

* * *

**(Figure No. 10)** — After cut-

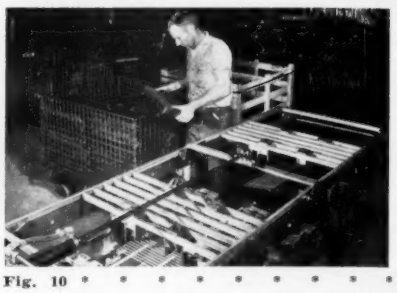


Fig. 10

ting to the proper width the shelves drop into a transfer table which carries the shelf in and out of chamfering tools which deburr the cut ends.

## Baskets

**(Figure No. 11)** — The market

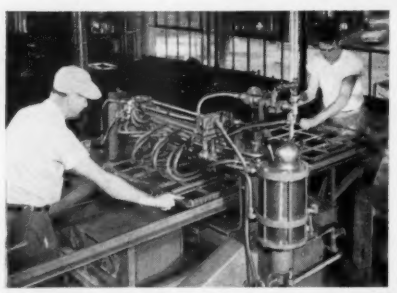


Fig. 11

for freezer baskets has increased tremendously in the past four or five years due to the fact that most refrigerators are designed to have a freezer compartment in the lower part of the box and a basket is required to give effective circulation and also ease of storage within the freezer compartment. In the design of baskets we have attempted to make all baskets in such a manner that all wire with

the exception of the top frame wire can be welded in mat form. From this picture you can see what is commonly called a Mat Welder. This is a series type welder so designed to allow us to weld all inner sections of the left to right and front to back wires at one time.

* * *

**(Figure No. 12)** — From this

Fig. 12 * * * * * * * * * *

photograph you can see where the mat has been folded and is being withdrawn from a hydraulic press. It is then processed to a single press operation and we now have a basket in its final shape.

* * *

**(Figure No. 13)** — In this weld-

Fig. 13 * * * * * * * * * *

ing operation you can see that we are welding with a press type welder. The intersection of all horizontal and vertical wire at the end of the basket are welded.

* * *

**In** the last operation you can see that the top frame has been added and the basket has been completed. All baskets produced by our company are produced in the sequence that we have shown with small variations required such as the addition of roller brackets, stop tabs and the like.

## Miscellaneous Production— Clothes Guard

**In** the prdouction of wire shelving and baskets we ourselves find it impossible to confine ourselves strictly to this production only.

* * *

**(Figure 14)** — Recently we were

Fig. 14 * * * * * * * * * *

asked to design and produce a clothes guard for an automatic washer. The purpose of the clothes guard was to prevent small items such as children's socks, small handkerchiefs and the like to be thrown out of the tub during the spin-dry action. We designed a part consisting of three wire rings joined by eleven radial stays. The ring was completed by the attaching of two sheet metal parts which were joined together by means of tabs after the part was installed in the washing machine. From this photograph you can see that we designed and built an index welding fixture which contained the rings and the radial stays so that the table could index and weld the radial stays to the rings at each location. Two tables were made so that one ring could be welded while the other fixture was being loaded.

* * *

**(Figure No. 15)** — This photograph shows the complete ring being prepared for finishing. The finishing of refrigerator shelves and freezer baskets is most exacting with specifications becoming tighter year after year. At the present time we have been asked to supply parts that would pass 96 hours in a standard ASTM Salt Spray Cabinet. Just recently the specifications have been changed from a 20% solution at 100°F to 5% Salt Spray Solution at 100°F.

Fig. 15 * * * * * * * * * *

In order to meet this type of condition, it is necessary to plate with either zinc or Copper, Nickel, Chrome and then apply a clear Epon coating which is baked for twenty minutes at 350°F. It might be well to bring out at this time that the only way a specification of this type can be met is to have a proper clean and smooth surface on the wire which we use. Our plating, both Zinc plating and Copper, Nickel, Chrome is done on automatic plating equipment.

* * *

**(Figure No. 16)** — This photo-

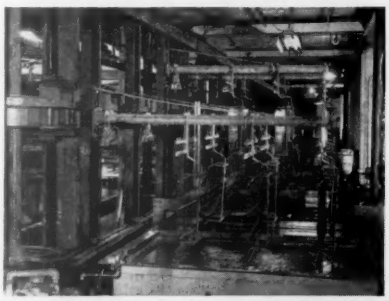


Fig. 16 * * * * * * * * * *

graph shows shelving being plated on our automatic nickel machine.

* * *

**(Figure No. 17)** — This photo-

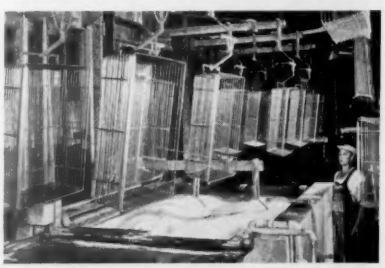
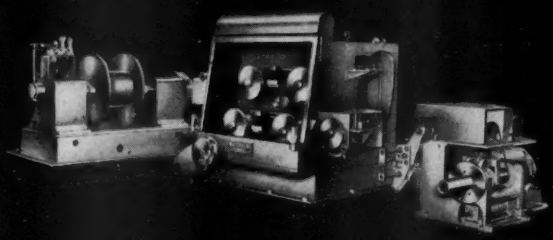


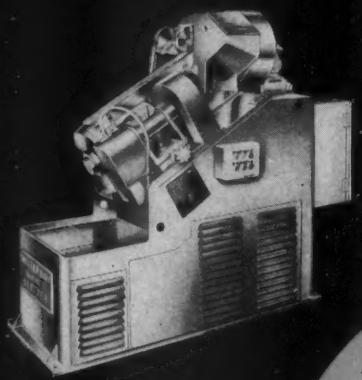
Fig. 17 * * * * * * * * * *

graph shows baskets being plated on our automatic zinc machine.

(*Please turn to page* 1676)

COLD HEADING
MACHINERY

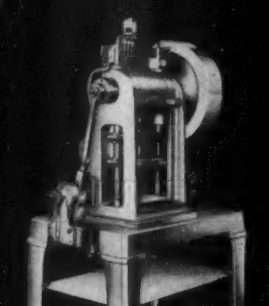




EYELET, SLITTER
& WIRE
MACHINERY

WATERBURY FARREL
MACHINERY BUILDERS

ROLLING MILL
MACHINERY



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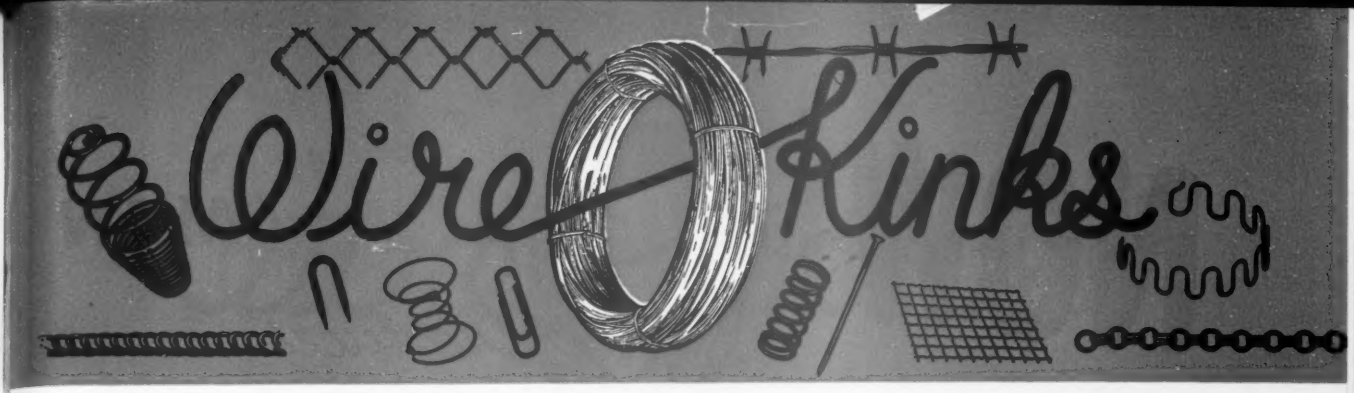


**In this department will be published helpful hints on how to do things and the questions asked by our readers on wire processing problems, together with the answers and comments thereon received from the field. In no instance will the identity of the persons asking for advice or of those supplying it be published.**

**Our readers are invited to send helpful contributions and to submit questions on their technical problems to the Editor. These will be answered from information on hand or from the field, when it becomes necessary to secure counsel from that source.**

## QUESTIONS AND ANSWERS

### Question

**Could** you supply information on the drawing of wire from C1010 or C1008 rod to produce bright basic wire with an extra clean finish, free from surface imperfections, for subsequent electrolytic plating? My questions are:

1. **Are the rods lime coated after pickling or has some other coating proven better?**
2. **What percentage of reduction between drafts is recommended for general practice?**
3. **Is the wire dry drawn to size without intermediate annealing and, if so, down to what gage?**
4. **Should the wire be grease drawn or will some other lubricant give best results?**

### Reply No. 1

**We** will try to answer the questions concerning Bright Basic Wire of plating quality. This, of course, is known as 'Extra Clean Smooth Bright Basic' in the commercial terminology.

1. The general practice is a light lime coat, although borax coating has been successfully used in some cases.
2. Percentage reduction, that is, drafting practice varies widely in various mills. For the product required, the writer believes a minimum of 40-50% reduction should be given, but that far better results are obtained from giving two comparatively light drafts of 20-25% rather than one very heavy draft, the whole purpose being to burnish the surface, which a very heavy draft will not do.
3. A 1008 or 1010 steel is drawn dry direct from the rod without annealing. These steels can be drawn 80% reduction or more before annealing for further reduction is required. There should therefore be no problem in this regard, unless very small wire sizes are to be made, or some very severe forming is to be done.
4. We would not use anything but grease lubricant for this work due to the necessity for easy cleaning and the surface polish required of the wire.

### Reply No. 2

**Following** is some information regarding the production of Bright Basic Plating Quality Wire with extra bright finish.

1. We have found light lime coating to be most suitable for production of bright extra clean wire for plating.
2. In order to obtain surface suitable for plating, we find a minimum of 50% reduction in drawing is necessary.
3. Wire is normally dry-drawn to size without annealing. The question of annealing would be determined by the softness of the material required for end use or if the diameter required is smaller than can be produced from hot rolled rod.
4. We find regular wire drawing grease more suitable for this type of work.

### Reply No. 3

**It** is difficult to answer questions in regard to the manufacture of bright basic plating quality wire as conditions in various mills differ so much. Type of steel, heating and rolling practices, water supply, chemical make-up of lime, type of drawing machines, etc, all enter into answering such questions.

* * *

**In** view of the above we submit the following answers to your questions:

1. We have been more successful in using lime coatings.
2. This would depend upon the type of machine and the end product desired.
3. Whether the rod is dry drawn to size with or without annealing depends upon the temper required by the fabricator.
4. We have had best results with grease drawn or wet drawn wire.

### Reply No. 4

**The** writer has prepared the following information relative to processes involved in the wire mill in producing extra smooth clean bright wire finish for subsequent electroplating — the steel involved being C-1008 or C-1010.

1. The general practice is to lime coat in the cleaning line with a very light lime coat and thoroughly bake the lime.
2. At least 30 to 35% reduction in area is recommended.
3. The green (hot rolled) rod in C-1008 or C-1010 may be drawn to as fine as 16 gage (.0625") before annealing becomes necessary. This is predicted on the use of a 7/32" (.218") rod which is the smallest rod size produced on most rod mills today. It should be kept in mind, however, that the tensile and

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# Wire Kinks

hardness increases with increasing percentages of cold work. Consequently the necessity for annealing in process may or may not be necessary depending upon the end use of the wire and amount of cold forming required.

4. General procedure is to grease draw, using a proven grease that gives best results for the individual mill practice.

* * *

**General** Comments — In passing out the above information, the writer wishes to point out that only a dry drawn wire has been considered and one that is direct drawn from the hot rolled rod. Naturally such additional procedures as **wet drawing** or **annealing in process,** which are added cost treatments, may be expected to materially improve smoothness and polish. Any one seriously interested in the subject of wire finishing should refer to the description of 'Wire Finishes', pages 32 and 33, carbon steel Rod and Wire Manual, published by the American Iron & Steel Institute, 150 E. 42nd St., New York 17, New York.

### Reply No. 5

**Referring** to your questions regarding the drawing of bright basic wire, plating quality, it is my suggestion to the inquirer to use a very clean heat of steel of either C1010 or C1012. This will mean that the copper should be .12 max. This material should be cleaned and either lime or borax coated. The reduction in area should be standard low carbon practice, and I would suggest that the wire be drawn through grease.

* * *

**The** question concerning drawing from annealed stock naturally must take into consideration tensile requirements. As to the finish of the wire itself, I believe that much depends upon the surface conditions they have in the rods. If the surface condition is not good, then annealed stock would do a better job. Of course, the cost angle must be considered. I would suggest that questions on lubricants be addressed to our lubricant suppliers, as they have many different lubricants that can be used on different types of equipment.

* * *

**The** question of making good plating quality wire is one of the keen points of interest of many of the boys in The Wire Association. If and when you get the answer how to make this material, I would appreciate receiving information. This is one of the toughest products that any low carbon mill in the United States has to solve. When the subject is discussed it usually ends up by someone saying: "Why don't you draw all the plating wire so we won't have the worries?" That will give you an idea of the rigid inspection that is given to this type of wire.

### Reply No. 6

1. The rods should be lime coated after pickling. Assuming the rod size to be ⅜", the rods would be given one dip in a 1% lime bath after the cleaning operation.
2. For one hole drafting to produce extra smooth clean bright finishes a minimum draft of 30% reduction in area is required.
3. Since there would be only one draft involved, annealing would not be necessary. The rods would be dry-drawn one hole to the finished size.
4. Extra smooth clean bright finishes can be produced by either two hole drafting through a mixture of grease and lime, or by one hole drafting through a soap-lime paste mixture.

* * *

**Both** of the above lubricants are made up in the mill. The two-hole grease and lime lubricant is made by mixing 50 pounds of Esso #1 Wire Drawing Grease with 150 pounds of hydrated lime. Thorough mixing is accomplished by tumbling the lime and grease in a rotating ball mill for about 30 minutes.

* * *

**The** one-hole soap-lime paste lubricant is compounded by gradually adding yellow soap (Armour's Flintcote) to a bucket containing an 8% lime suspension and stirring until a paste is formed. After the paste is allowed to age for about 2 weeks it serves as an excellent one-hole lubricant to produce extra smooth clean bright finishes.

### Wire Bend Test Jig

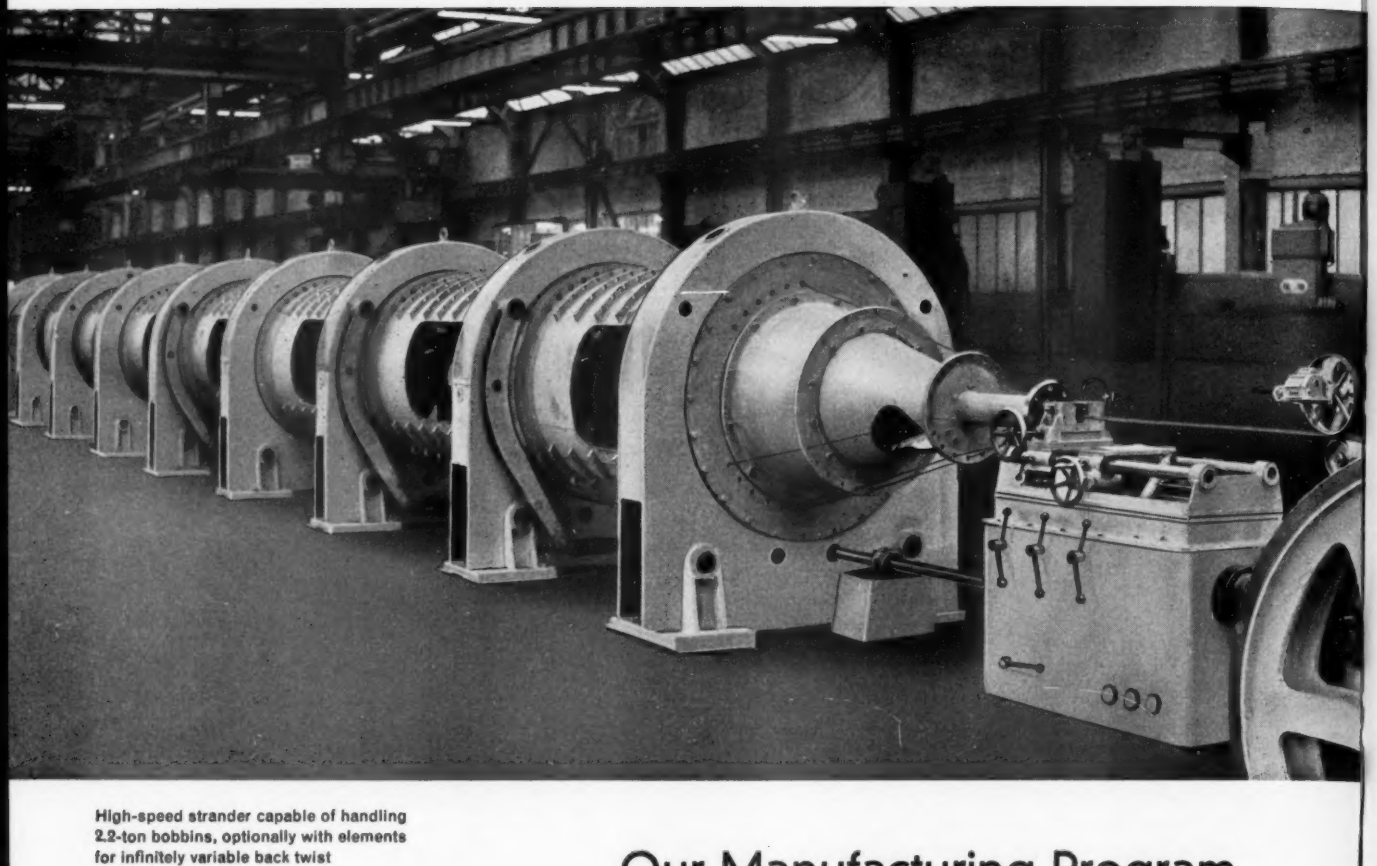
**The** inspection section of the metallurgical department, Houston, Texas works of Sheffield Division, Armco Steel Corporation, had a problem of bending a large volume of wire and rod.

* * *

**ASTM** A 82 - 58 T specification for cold drawn steel wire for concrete reinforcement requires that material meeting this specification must be bent cold 180° around a pin, the diameter of which is equal to twice the diameter of the specimen. The method being used to bend the wire was laborious and dangerous, as the wire had to be bent by a man pulling on a handle, and occasionally a specimen would slip and the man would loose his balance.

(*Please turn to page* 1661)

# KRUPP



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# Glass Sealing Wires

by Robert R. Brenan
Senior Engineer — Wire
Sylvania Parts Division
Sylvania Electric Products, Inc.
Warren, Pennsylvania

A paper presented at the Annual Convention of The Wire Association on October 14, 1959, at Cleveland, Ohio.

## Introduction

**The** art of sealing metals to glass is an ancient one. The techniques of enameling and the sealing of precious metal foil to glass have been practiced for many centuries. However, except for the 19th century use of platinum as a glass sealing wire, present day materials' and methods' technology are 20th century developments. The rapid growth of the manufacture of the low cost products of our electronic and lighting industries has been dependent on a similar growth in glass-to-metal sealing techniques.

* * *

**This** paper presents the principles of sealing wire in glass which have become apparent over the years of investigation and production. The scope of the subject is such that it necessitates the inclusion of a discussion of glass and its characteristics as well as the metals involved, and the difficulties encountered in sealing one to another. It should be noted that although this paper is confined to a discussion of internal seals, that is, the glass surrounds the wire, many of the sealing materials discussed are used in other forms such as strip, ribbon, or stamped parts and as such may be bonded to glass to form external, butt, tubular, window, or other type seals. These are beyond the scope of this paper and will not be mentioned again.

* * *

**Throughout** the paper, generous use is made of references to which the reader is referred for additional or more detailed information.

* * *

A true glass-to-metal seal as discussed herein refers to one in which the glass and metal have become tightly bonded one to the other and form a gas tight or impervious seal. No consideration is given to seals which require the use of any resin, sealing wax, pitch, solder, etc. to make them gas tight.

* * *

**The** uses of glass sealing wires are obvious, ranging from lamp and flash bulbs through radio tubes and complex electronic equipment. The sealing wires perform the function of conducting electrical power, impulses, or signals into and out of the sealed envelope. The glass, in addition to sealing to the wires and electrically insulating them, may form the envelope as in a lamp. A special category is hermetic sealing which can give a standard part, a relay for instance, a longer and more reliable life by eliminating its exposure to dust, dirt, moisture, and fungus growth.

* * *

**Automatic** equipment is normally used to join the lead wires to the glass and form a completed stem or header as shown in Photo 1. Additional automatic equipment and hand operations are used to add the necessary filaments, plates, etc. and to seal the envelope in place. Photo 2 illustrates diode components. Note that the section

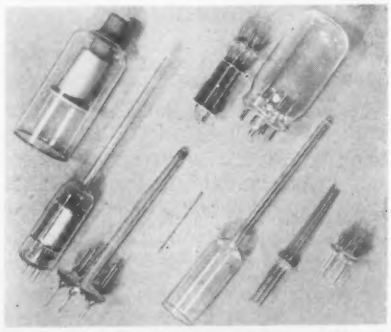


Photo 1 — Stems and Sub-Assemblies (¼ size)

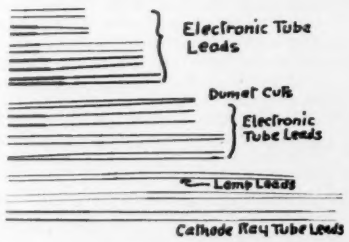



Photo 2 — Lead Wires (about ½ size) * *

sealed in the glass may be quite short, often as small as two millimeters in length. Since the cost of the sealing wire is considerably higher than that of other wires, and since it may not possess the required properties for use inside or outside of the sealed envelope, the use of two- and three-piece lead wires is common. During the sealing operation the glass and lead wires are heated by gas-oxygen flames until the viscosity of the glass has been lowered to the point where it will flow by gravity or may be pressed into the desired shape.

* * *

**The** stems or headers may also be manufactured by assembling the lead wires on jigs along with preformed glass and bonding by furnace sintering.

## Prerequisites for Glass Sealing Wires

**There** are two main criteria which govern whether or not a particular metal and glass combination may be joined together to form a satisfactory seal. These are:

1. **During the sealing operation the glass must "wet" and adhere to the surface of the metal. Experience has shown that the "wetting" is greatly facilitated by either the use of a preoxidized wire or by oxidation of the wire occurring during the sealing operation. As the glass is heated and becomes less viscous, it flows on the oxidized metal and the**

oxide begins to dissolve in the glass. If heating is continued long enough, a bright metalic surface will appear beneath the glass with all the oxide having gone into solution. The ideal situation appears to be one where, after sealing, a continuous bridge is formed from glass through oxide to metal with some residual oxide color in the seal. It has been shown that glass will not wet metal when fired under highly reducing conditions such as in hydrogen atmosphere. Excellent wetting occurs, however, if the metal is preoxidized and then heated with glass in an inert atmosphere, such as nitrogen. The oxide layer must not be allowed to become too thick for then it may not dissolve to the proper degree in the glass and thus a porous oxide path for gas leakage will be established. Experience has also shown that the color of the seal is a good measure of the amount of undissolved oxide remaining and, therefore, it is often used as a control measure.

2. The second criterion maintains that the seal established in 1. shall not be broken by any condition which may exist during either manufacture or service. This requires that the expansion curves of the glass and metal be as nearly identical as possible over the temperature range between the strain point of the glass and the lowest service temperature to be encountered. As will be shown later, the non-linear expansion curves of the various glasses complicate the procedure, although through the use of special metals and alloys some reasonably good matches are obtained. Allotropic transformations which may occur in metals must be avoided since they are accompanied by sudden changes in length. Inflection points though are desirable as they permit the design of lead wires which follow the non-linear expansion patterns of the glasses over the desired temperature range.

* * *

Other criteria for a good lead wire include the ability to withstand the heat of the flames during sealing, the capacity to carry the required electrical load without undue heating, an absence of defects which could cause gas leakage, good weldability, freedom from evolved gas in the seal area, and a production process which will provide a consistent high-quality product at a reasonable cost.

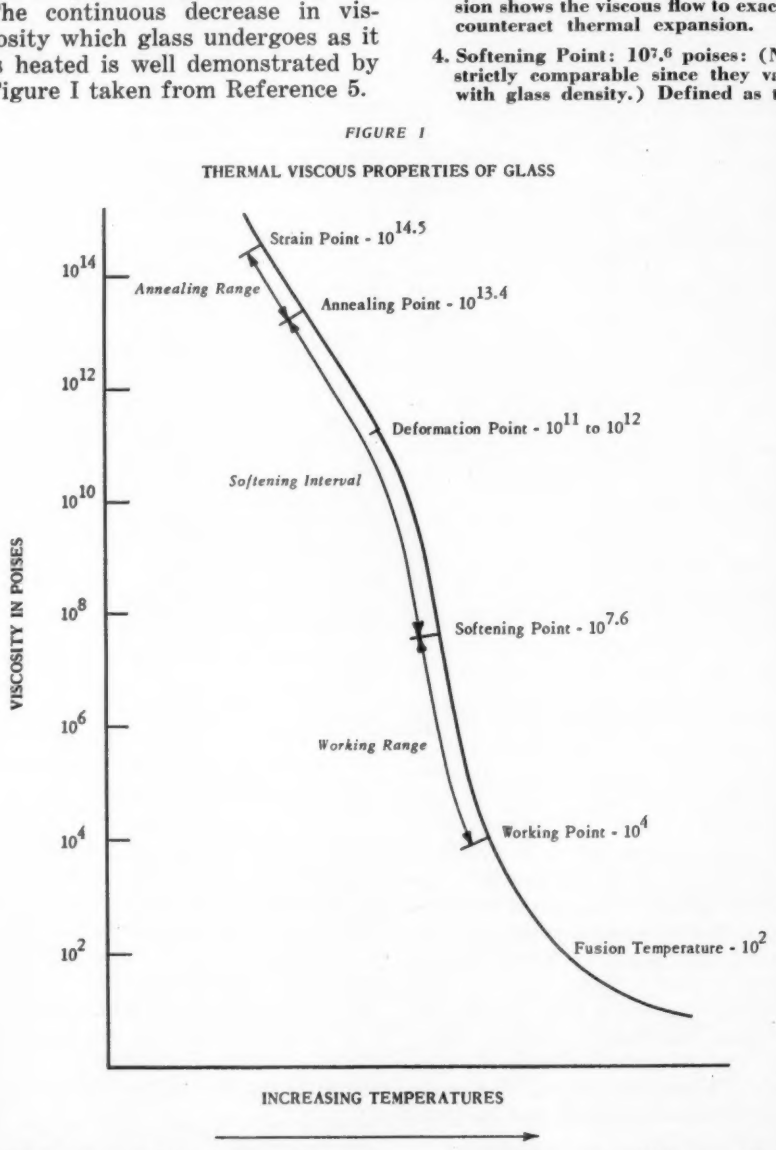
## Glass

Glasses are composed primarily of oxides, the predominate one being silica — $SiO_2$. The oxides of aluminum, sodium, potassium, magnesium, calcium, boron, barium, lead, iron, and other elements may be included, either singularly or in combinations, to yield a glass of the desired properties.

Glass has been defined as, "an organic substance in a condition which is continuous with and analogous to, the liquid state of that substance, but which, as a result of a reversible change in viscosity during cooling, has attained so high a degree of viscosity as to be for all practical purposes rigid." [3] The continuous decrease in viscosity which glass undergoes as it is heated is well demonstrated by Figure I taken from Reference 5.

*FIGURE 1*

THERMAL VISCOUS PROPERTIES OF GLASS




This is a plot of the thermal-viscous properties of glass in general. One specific glass will vary from another only in the temperatures where the various points occur. Other meanings and significance may be attached to these points in addition to viscosity definitions:

1. Strain Point: $10^{14.5}$ poises: (The lower end of the annealing range.) Below this temperature there is practically no viscous yield. At this point glass is said to anneal in sixteen hours.
2. Annealing Point: $10^{13.4}$ poises: (The upper limit of the annealing range.) Exposure here for 15 minutes will cause thermally induced stress to decay to an inappreciable value.
3. Deformation Point: $10^{11}$ to $10^{12}$ poises: Also the point where an interferometer measurement of expansion shows the viscous flow to exactly counteract thermal expansion.
4. Softening Point: $10^{7.6}$ poises: (Not strictly comparable since they vary with glass density.) Defined as the temperature at which a uniform fiber, .5 to 1.0 millimeter diameter and 22.9 centimeter long, elongates under its own weight at a rate of 1 millimeter per minute when the upper 10 centimeter of its length is heated in a prescribed furnace at the rate of approximately 5°C./minute. Figure shown is for a glass of 2.5 grams/cubic centimeter density.
5. Working Point: $10^{4}$ poises: The upper end of the working range where glass is generally formed into shapes.
6. Fusion Temperature: $10^{2}$ poises: At

**this point a batch charge is considered completely converted into glass.**

* * *

**These** definitions are from Reference 5.

* * *

**The** constant change in viscosity of glass as it is heated allows it to become very fluid without going through a melting point as in the case of metals. On cooling the glass there is no freezing point and no crystallization takes place. Through certain heat treatments a type of crystallization known as devitrification may be brought about but, as this condition adversely affects the properties of the glass, it is avoided, except for the latest pyrocerain glass materials.

* * *

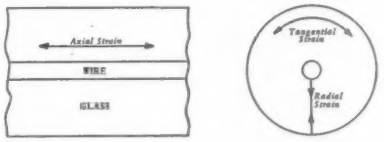
**The** glasses used for sealing wires may be divided into two basic groups, the "soft" glasses and the "hard" glasses. The "soft" glasses have the higher thermal expansion characteristics, usually around 90 x $10^{-7}$ unit/unit/°C., and soften at lower temperatures than the "hard" glasses. Thermal expansion of the "hard" glasses is one half that of the "soft", running about 45 x $10^{-7}$. Please refer to Table I for comparison of properties of typical "hard" and "soft" glasses.

* * *

**The** strain existing in the glass surrounding a metallic wire may be broken down into three components: axial strain, radial strain, and circumferencial strain. These strains have definite relationships one to the other and depend on which of four possible states exist. Starting from a strain free condition, a section of heavy glass beaded wire will show the strain relationships as indicated on Figure II. Expanding this situation to include a multiple wire seal made with a lead wire which has a radial expansion considerably different from its axial expansion (a situation to be discussed later), it may be seen that complex strain patterns exist. These patterns will be modified by thermal gradients during the sealing and subsequent cooling operations which through non-uniform cooling cause viscous yielding to take place in some areas and not in others. The usual policy is to follow the sealing operation with an annealing cycle which is governed to produce the optimum strain condition for the part in question.

*FIGURE II*

STRAIN CONDITIONS IN GLASS




| THERMAL STATE | EXPANSION STATE | GLASS STRAIN STATE AXIAL | RADIAL | TANGENTIAL |
|---|---|---|---|---|
| Heating | Expansion of Metal greater than Glass | Tension | Compression | Tension |
| Cooling | Expansion of Metal greater than Glass | Compression | Tension | Compression |
| Heating | Expansion of Metal less than Glass | Compression | Tension | Compression |
| Cooling | Expansion of Metal less than Glass | Tension | Compression | Tension |

TABLE I

PROPERTIES OF GLASSES

| Type | No. Designation | Thermal Expansion Unit/Unit/°C 20 to 300°C Range | Annealing Point | Softening Point | Working Point | Uses |
|---|---|---|---|---|---|---|
| Soda Lime | 0080 | 92 x $10^{-7}$ | 510 | 696 | 1000 | Lamp Bulbs |
| Potash Soda Lead | 0010 | 91 x $10^{-7}$ | 428 | 626 | 970 | Stems for Lamps and |
| Potash Soda Lead | 0120 | 89 x $10^{-7}$ | 433 | 630 | 975 | Bulbs |
| Chrome-Steel Sealing Glass | 0210 | 96 x $10^{-7}$ | 425 | 607 | | High Temperature |
| Similar to 0120 | 0160 | 92 x $10^{-7}$ | 433 | 627 | | Tubes, Miscellac, |
| Similar to 0120 | 0161 | 92 x $10^{-7}$ | | | | etc. |
| Multiform | 7295 | 154 x $10^{-7}$ | 366 | 465 | 655 | Copper Sealing Glass |
| Borosilicate | 7040 | 47.5 x $10^{-7}$ | 494 | 702 | 1000 | Kovar |
| Borosilicate | 7050 | 46 x $10^{-7}$ | 496 | 703 | | Molybdenum Sealing |
| Borosilicate | 7060 | 50 x $10^{-7}$ | 495 | 690 | | |
| Borosilicate | 7052 | 46 x $10^{-7}$ | 475 | 708 | 1115 | Most popular. Kovar Sealing. Molybdenum |
| Borosilicate | 7720 | 36 x $10^{-7}$ | 518 | 755 | 1110 | High wattage lamps and tubes. Tungsten |
| Borosilicate | 7740 | 33 x $10^{-7}$ | 565 | 820 | 1220 | Tungsten Sealing. |

Note: The No. Designation is the Corning four number code which has found widespread use in the glass sealing industry.

## Metals

**The** conductors used as glass sealing wires may be separated into three basic groups — pure metals, alloys, and composites. Although all groups are used by today's production methods, by far the greatest volume of seals is produced using a material from the composite group — dumet.

* * *

**1. Pure Metals:** Pure metals (commercial grade) exhibit linear thermal expansion characteristics over the range of temperatures encountered in seal making. Figure III shows the thermal expansion curves of four commonly used metals and several glasses which could be used with them.

* * *

**a. Platinum: Of the pure metals, platinum was the earliest to be used, but has been limited to very special applications by its cost. Early incandescent lamps and electronic tubes depended almost entirely on platinum wire seals. Except for the cost factor, platinum in many respects possesses excellent lead wire properties. Its thermal expansion coefficient of 92x $10^{-7}$ matches well with most "soft" glasses. (Figure II shows platinum compared with 0120 glass.) Its low yield strength allows some relieving of the stresses set up in these seals. Platinum's high melting point and excellent resistance to corrosive elements can be significant factors in design on critical applications. The heating of platinum to temperatures involved in glass sealing and cooling to room temperature does not form any visible surface oxide. Reference 5 gives information indicating that the surface must form a slight oxide layer since the wetting ability of glass on platinum is increased by the presence of oxygen. Its electrical resistance is comparatively good for a lead wire material. Platinum is extremely ductile and may be either hot or cold worked. It is good practice to chemically clean or pickle platinum (10 to 15% HCl recommended) prior to annealing, otherwise contamination by diffusion may occur.**

**b. Tungsten: Tungsten possesses several properties which brought about its use as a glass sealing wire. Its thermal expansion allows good seals to be made with the "hard" glass group and both thermal and electrical conductivities are excellent. Unfortunately, tungsten must be manufactured by powdered metallurgy techniques and the resultant product is hard, brittle, and relatively expensive.**

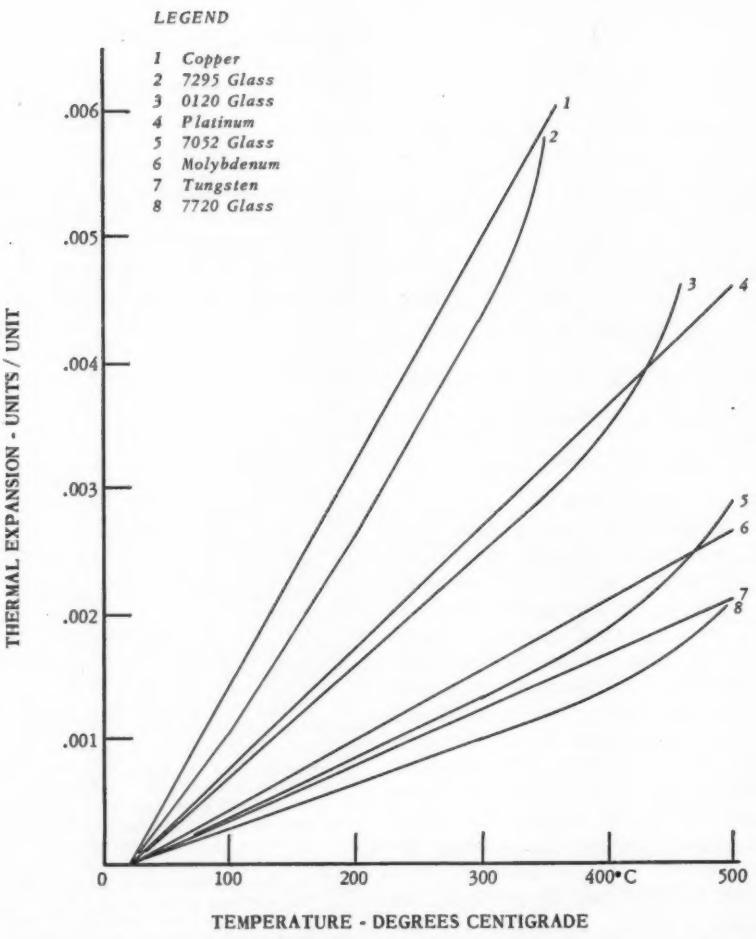
* * *

**The tungsten powder is compressed, sintered, and hot swaged into fibrous structured rods. These rods may be hot drawn into wire but care must be**

*FIGURE III*

**PURE METALS**

*Thermal Expansion of Four Glass Sealing Metals and Companion Glasses.*




**taken not to exceed the recrystallization temperature of about 1000°C. or the loss of the fibrous structure due to grain growth will yield a brittle wire.**

* * *

**Rod sizes of .040″ to .080″ diameter may be used although rods .200″ diameter have been sealed in glass. These rods are usually centerless ground to remove the surface defects such as longitudinal seams and fissures. The ground surface may be preoxidized prior to sealing in glass and even precoated with glass to assure attainment of the proper oxide. This precoating, known as beading, may be done by slipping a close fitting glass tube over the tungsten rod and quickly sealing it to the wire's surface. The "beaded" part will then seal readily in a glass-to-glass seal. This method avoids the handling of a preoxidized part and possible injury to a fragile oxide coating. Tungsten is frequently used on high wattage applications.**

* * *

**c. Molybdenum: This metal is very similar to tungsten in that it matches the "hard" glass group in expansion and exhibits good thermal and electrical conductivities. Its methods of manufacture are also similar to tungsten but it is much more easily worked. It may be cold drawn and annealed to recrystallize the grain structure.**

* * *

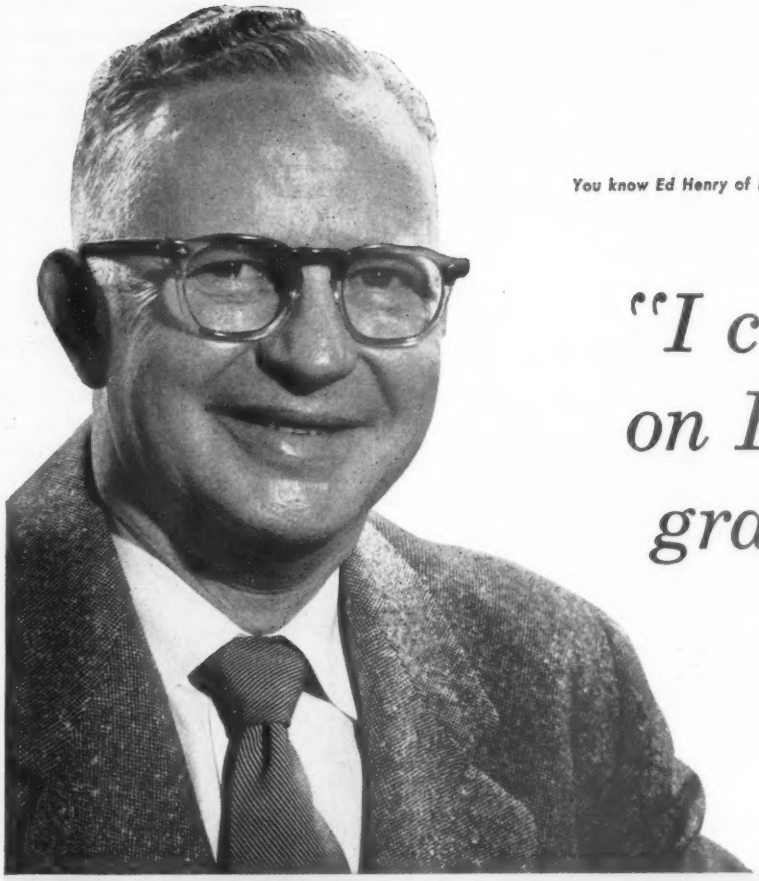
**Its tendency to form thick non-adherent oxide films during sealing dictates the use of "beading" to establish controlled sealing conditions. Molybdenum may be used in fine wires or rods up to .375″ diameter, and although rods are available in the ground and polished condition this is not as necessary as in the case of tungsten since it is less susceptible to cracks and flaws. Molybdenum may also be used on high wattage applications.**

**d. Copper: This metal rates as excellent in thermal and electrical conductivities, oxidizing characterictics, cost, and availability. Unfortunately, its thermal expansion is very high and it cannot be used as a lead wire with either the soft or hard glasses. Figure III illustrates a specially prepared glass, Corning 7295, which is available as a multiform unit and which can be used with it.**

2. **Alloys:** This second group of sealing wires is extensive and only the most prominent of the alloys which can be used will be mentioned. These are shown on Figure IV with companion glasses. Note that the expansion of these alloys is not a straight line but contains an inflection point where a rapid change in rate of expansion is observed. Since the inflection point may be moved by judicious juggling of the alloy composition, the formation of alloys which have excellent thermal expansion matches with their corresponding glasses is possible. These alloys are generally of the nickle-iron, chrome-iron, chrome-nickel-iron and nickel-cobalt-iron groups. The nickel-iron alloys in the 42 to 52% nickel range are attractive since they have expansion characteristics similar to the glasses. The inflection points, ranging from 650 to 965°F. with increasing nickel content, bring out the necessity of the glass being a close expansion match not only over the temperature range involved during sealing, but also at any point along the range. The oxide which forms during sealing of the nickel-iron alloys is of a loose scaly nature and while it dissolves in the glass, it tends to separate from the metal at the metal-oxide interface. This obstacle was overcome by W. E. Kingston's development of Sylvania No. 4 Alloy.

* * *

**This** alloy, with a composition of 42% nickel, 6% chromium, balance iron, is also marketed as D-H No. 14, Carpenter "426", and Sealmet No. 4. The addition of chromium to the nickel-iron system has the effects of raising the expansion and promoting the formation of a stable, adherent oxide film. The chrome-iron system is characterized by a 28% chrome alloy known variously as Ascoloy 446, Allegheny 55, Carpenter 27, and Sealmet I. During sealing the high chrome content causes the forma-



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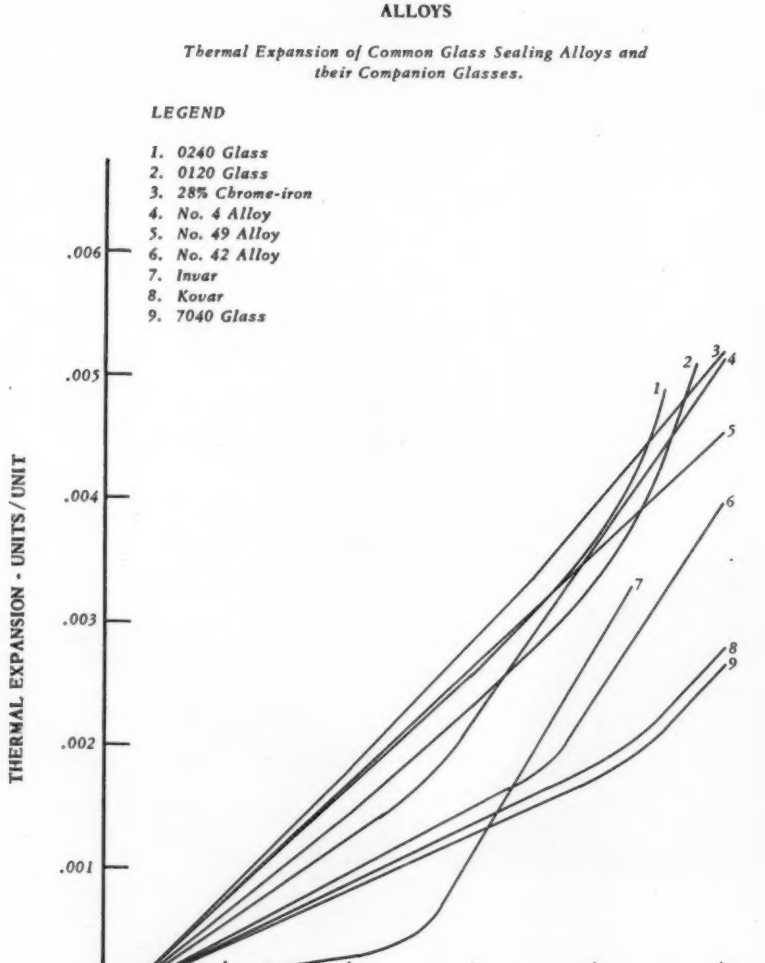
*Division* **WATCH COMPANY** ELGIN, ILLINOIS

*FIGURE IV*

**ALLOYS**

*Thermal Expansion of Common Glass Sealing Alloys and their Companion Glasses.*



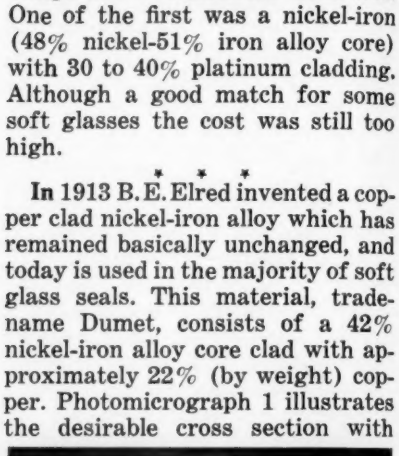

tion of a tightly adherent chromic oxide film which then inhibits the formation of scaly iron oxides. This chrome oxide is very tenacious and must be removed by sand blasting or chemical treatment prior to spot welding. Preoxidation of this alloy is often accomplished through high temperature heat treatment in wet hydrogen to form the protective chrome-oxide coating. The nickel-cobalt-iron alloys are best illustrated by the Westinghouse developed alloy with the composition of 28% nickel-18% cobalt-53% iron — known variously as Kovar, Therlo, or Rodar. This alloy as well as the previously mentioned No. 4 Alloy may be preoxidized. Table II shows general preoxidation methods which may be used, although the exact oxidation characteristics will depend on the wire's surface condition, cleanliness, etc.

* * *

**3. Composite Wires:** As previously mentioned, platinum was the original lead wire material, being used in Edison's lamp work of 1879 and later in electronic tubes and lamps. The high cost of platinum resulted in the search for and development of substitute materials. One of the first was a nickel-iron (48% nickel-51% iron alloy core) with 30 to 40% platinum cladding. Although a good match for some soft glasses the cost was still too high.

* * *

In 1913 B. E. Elred invented a copper clad nickel-iron alloy which has remained basically unchanged, and today is used in the majority of soft glass seals. This material, tradename Dumet, consists of a 42% nickel-iron alloy core clad with approximately 22% (by weight) copper. Photomicrograph 1 illustrates the desirable cross section with



Photomicrograph 1

Dumet - Copper Clad 42 Alloy
shows desirable even copper coating
Mag. 200X

evenly distributed copper sheath. Dumet is made in large quantities by hydrogen furnace brazing of a copper sleeve to the nickel-iron alloy core followed by reduction through conventional wire drawing methods to finish sizes of .006" to .040". Because of its composite nature, the thermal expansions in

TABLE II

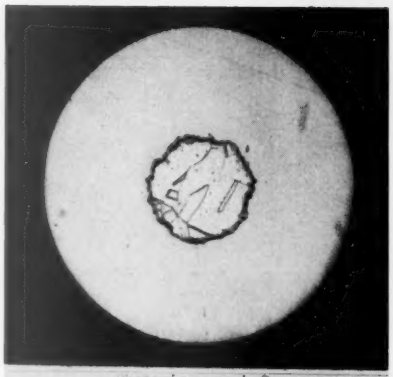
PREOXIDATION METHODS

| Alloy Type | Time | Temperature | Gas Atmosphere | Oxide Color |
|---|---|---|---|---|
| (No. 4 Alloy) Nickel-Chrome-Iron | 30 min. | 2300°F | Wet dissociated ammonia. Saturated at room 80°-110°F. | Brownish-Green |
| Chrome-Iron | 6-7 min. | 1160°C | Wet dissociated ammonia. Saturated at room 80°-110°F. | Green |
| (Kovar) Nickel-Cobalt-Iron | 17 min. | 800°C | Wet dissociated ammonia. Saturated at room 80°-110°F. | Mouse-grey or brownish |
| | | 650°C | Slight oxidising atmosphere. | Mouse-grey or brownish |

the radial and axial directions are different, making it impossible to obtain a really good match with any glass. This results in a considerable residual strain in dumet to glass seals. The ability of the thin copper layer to yield and distribute the strains greatly aids establishing a serviceable seal. This strain condition limits the general use of dumet to wire diameters of .020″ and smaller. Wires of .040″ and even .050″ diameters are occasionally used but they amount to a very small per cent of the total production (<.5%) and the seals are subject to cracking. As in the case of the alloys, dumet usually is preoxidized to facilitate the sealing process. This oxidation, known as borating, consists of converting the bright drawn copper surface to a red-copper oxide, $Cu_20$. The process is carried out by passing the wire through a gas flame, then into the "borating solution" (sodium tetraborate and water at 140°F. and 1.035 specific gravity), and finally through another gas flame where the wire is brought to a red heat. The process is continuous assuring uniform treatment of large quantities of wire. As the wire passes through the first burner an ultra thin layer of black cupric (Cu0) oxide is formed. Within the borating solution this Cu0 is reduced to $Cu_20$, the red oxide, and in leaving the solution a thin film of sodium tetraborate clings to the wire. Passing through the final flame the water content of this film is driven off and the coating becomes smooth and glass like. Annealing of the wire is also accomplished through the heat attained in this final flame. The thickness or weight of the film may be controlled visually by color and is normally produced to three color ranges. The "light" range is almost a yellow-red while the "regular" is a rich red and the "dark" is a deep purple-red. Oxide weights will vary from about .5% for light through 1% for regular to 1.5% for dark. The color range used in a particular instance depends upon the established practice, although the tendency is toward the lighter oxides since they dissolve in the glass more quickly, thereby allowing higher seal production rates. The final processing of dumet wire involves the inspection of the copper coating and the elimination of defective areas, exposed core due to welds, scrapes, etc. This is accomplished by continuously passing the wire through an electronic detection device. Although normally made as described above, dumet with special expansion properties may be prepared by selecting the appropriate core material and by varying the per cent copper cladding used.

* * *

**Other** composite materials include the use of 89% (by area) Kovar or No. 52 Alloy Clad Copper. Photomicrograph 2 illustrates this composition. These materials were developed to improve the thermal conductivity of the sealing wire rather than to adjust the expansion. Figure V shows the expansion curve of Kovar Clad Copper as compared to standard Kovar rod and No. 52 Alloy Clad Copper as



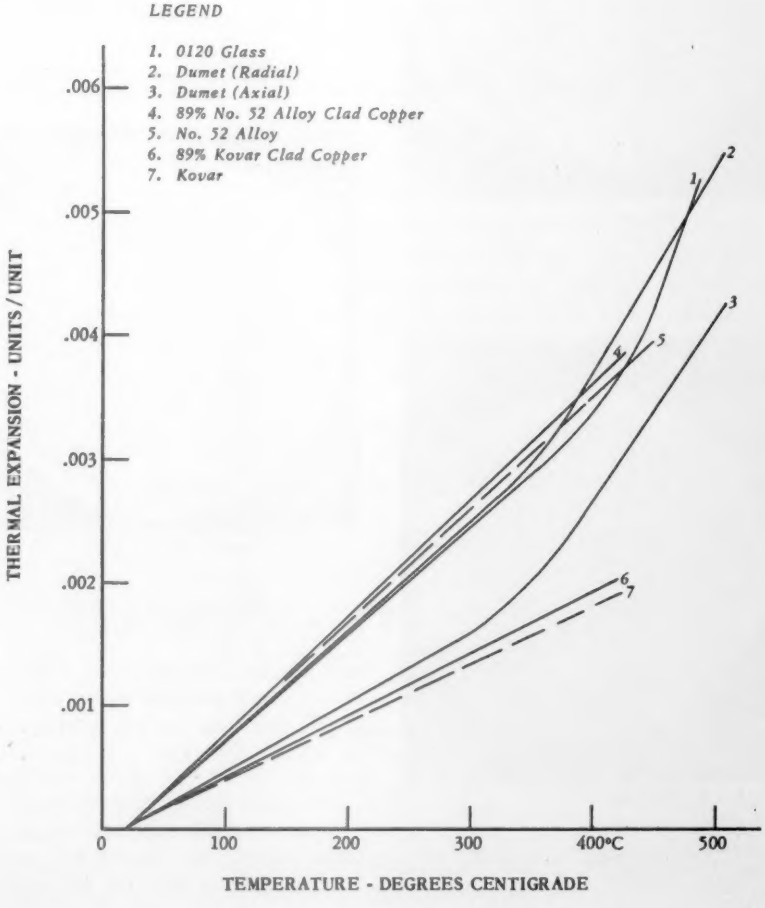
Photomicrograph 2

89% Kovar Clad Copper
showing relative core & sheath diameters
Mag. 200X

*FIGURE V*

COMPOSITES

*Thermal Expansion of several Glass Sealing Composite Metals.*



compared to regular No. 52 Alloy rod. Note that the increase in expansion is less than 10% over the 20 to 400°C. range. These materials are used in the larger sizes: .040" to .060" as lead wires and heat dissipators for semiconductor devices.

* * *

Please refer to Table III for information and comparison of the various glass sealing wires mentioned.

## Quality

The critical requirements of present day electronic tubes and lamps and their highly competitive manufacture dictates that wires for glass sealing be of the highest possible quality standards. In addition to meeting dimensional and mechanical property specifications, glass sealing wires must be free from any defect which may be cause for gas leakage either into or out of the sealed envelope. In the pure metals and alloys these defects include surface imperfections such as improper oxide, cracks, seams, slivers, die marks, and internal flaws such as pipe. In composite materials additional factors such as irregular, off center, or exposed core must not occur. Poorly bonded sheathing also may provide a leakage path for gases. Some of these defects are illustrated in Photomicrographs 3

(*Please turn to page* 1679)

TABLE III

GLASS SEALING METALS

| Type | Composition | Thermal Expansion Unit/Unit/°C (1) | Inflection Point °C | Thermal Cond., cal/cm²/cm/°C/sec. | Elect. Cond. Microhm Cm | Expansion Classes for Wire Seals | Oxid Oxide Color | Melting Point °C |
|---|---|---|---|---|---|---|---|---|
| Platinum | - | 92 x $10^{-7}$ | - | .166 | 10.6 | 0030,0010, 0120 | Metallic | 1750 |
| Tungsten | - | 44 x $10^{-7}$ | - | .38 | 5.6 | 7720,7740 | Metallic or Red Brown to Straw Yellow | 3250 |
| Molybdenum | - | 55 x $10^{-7}$ | - | .35 | 4.8 | 7052,7060 | Metallic or Brown | 2450 |
| Copper | - | 180 x $10^{-7}$ | - | .92 | 1.75 | 7295 | Red to Yellow to Metallic Copper | 1083 |
| Invar (2) | 36% Ni Bal. Fe | 16 x $10^{-7}$ 0°F→ 350°F | 190 | .026 | 82 | - | - | 1460 |
| #42 Alloy | 41.5% Ni Bal. Fe | 66 x $10^{-7}$ | 343 | .026 | 71 | 1075 | Grey | 1450 |
| #49 Alloy | 49% Ni Bal. Fe | 90 x $10^{-7}$ 20- 350°C | 593 | .031 | 48 | 0120 | Grey | 1440 |
| #52 Alloy | 50-51% Ni Bal. Fe | 95 x $10^{-7}$ 20 -500°C | - | .0399 | 43 | 0120,5010 | Grey | 1435 |
| #4 Alloy (3) | 42% Ni 6% Chrome Bal. Fe | 98 x $10^{-7}$ | 240 | .029 | 94 | 0080,0010, 0120,8160 | Greenish-Brown | 1460 |
| 28% Chrome-Fe (4) | 28% Chrome Bal. Fe | 110 x $10^{-7}$ | - | .059 | 72 | 0024,0080, 0010 | Greenish-Brown | 1475 |
| Kovar (5) | 29% Ni 17.5% Co Bal. Fe | 47 x $10^{-7}$ | 400 | .046 | 49 | 7052,7040 | Grey to Brown | 1450 |
| Dumet | 42 Alloy core 22% (by wt.) OFHC Sheath | Radial 80-100x$10^{-7}$ Axial 65- 75x$10^{-7}$ | 343 | .4 | 16 | 0080,0010, 0120 | Red to Yellow Metallic Cu | |
| 52 Alloy Clad Copper | OFHC Cu core 89% 52 Alloy Sheath | 96 x $10^{-7}$ | - | .135 (6) | 12.5 | 0120,9010 | Grey | |
| Kovar Clad Copper | OFHC Cu core 89% Kovar Sheath | 51 x $10^{-7}$ | 400 | .11 (6) | 14 | 7052,7040 | Grey to Brown | |

Notes: (1) All expansions given over 20° to 400°C unless otherwise noted.

(2) Invar not a glass sealing alloy; shown for information purposes only.

(3) Also known as Driver-Harris No. 14, Carpenter 426, Sealmet No. 4.

(4) Also known as Ancoloy 446, Allegheny 55, Carpenter 27.

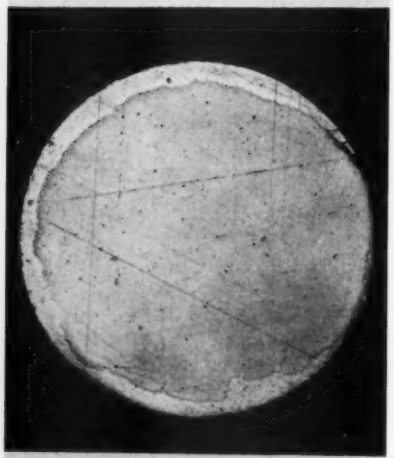
(5) Also known as Rodar or Therlo.

(6) Calculated.

**Correction: Conductivity in above table should be shown as 8, instead of 46.** * * * *

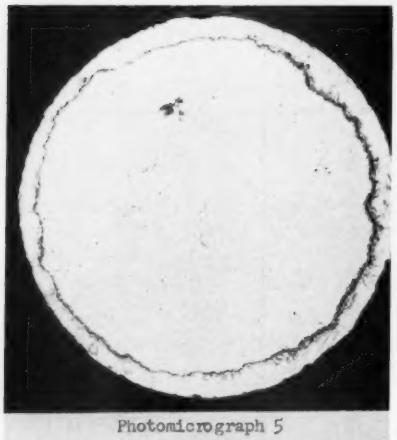
Photomicrograph 3

Dumet
Cladding broken & torn away
Mag. 200X



Photomicrograph 4

Dumet
Exposed Core
Mag. 200X

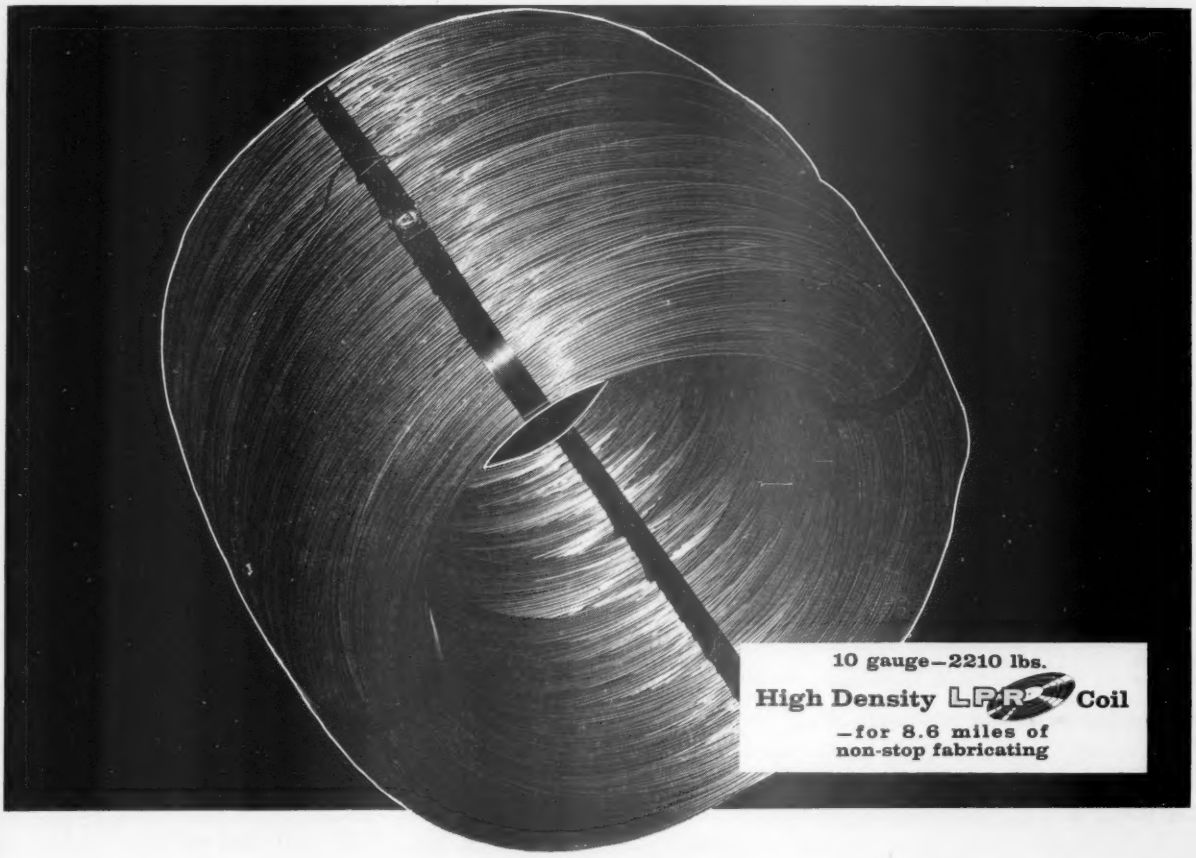


Photomicrograph 5

Dumet
Pipe in 42 Alloy Core
Mag. 80X

Photomicrograph 6

Dumet
Seam in 42 Alloy Core
Mag. 175X

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Anon. Indian Wire Ind Journ 1959 Vol 2 (7) pp 101-103 (July)

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MEASURING INSTRUMENTS FOR DRAWING DIES

Anon. Indian Wire Ind Journ 1959 Vol 2 (7) pp 98-100 (July)

**Special instruments have been developed for measuring and inspecting polishing needles, drawing angles and blend radii on the approach side, as well as bearing lengths and the surface finish of die contours. The Zetmeter uses the two needle principle to measure the blend radius and the cylindrical portion of the die profile or die bearing, miniature dial indicators limiting travel of the gauging needle and thus eliminating the effect of hand pressure. Measuring range is 0.008 to 0.31 in. bore diameters, and under shop conditions the operation takes about 20 seconds. A taper indicator checks polishing needles, with taper angles from 5° to 30°, in about six seconds. The Panhol instrument examines surfaces of die bores, using a pin with a conical reflecting surface which can check even small diameter holes satisfactorily. All instruments are designed for practical use in wire drawing shops. 6 illustr.**

WET WIREDRAWING

J. K. Annandale. Wire Ind 1959 Vol 26 (308) pp 741-743, 745-746 (Aug) 4 illustr.

BERYLLIUM WIRE

Brush Beryllium Co. Met Progr 1959 Vol 76 (2) pp 23, 25 (Aug)

**Pure beryllium wire has been drawn successfully under laboratory conditions, using standard wire drawing equipment and a specially designed pre-heat furnace. Drawing temperature, die design, crystallography, and the use of a proper starting material appear to be the most critical variables in the process.**

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D. J. Jones, A. Leach. Metallurgia 1959 Vol 60 (357) pp 7-11 (July)

**The extraction of the metal from its ores and its manufacture into filaments by compacting, sintering, swaging, and wire drawing are described briefly, and factors influencing the stability of metallographic structures are discussed in relation to the service behavior of the lamp. Diamond dies replace carbide dies at approximately 0.3 to 0.5 mm wire diameter. 6 illustr, 6 ref.**

A NEW LAYOUT SAVES SPACE IN FEEDING WIRE TO FINE DRAWING MACHINES

Anon. Wire Ind 1959 Vol 26 (308) p 752 (Aug) 2 illustr.

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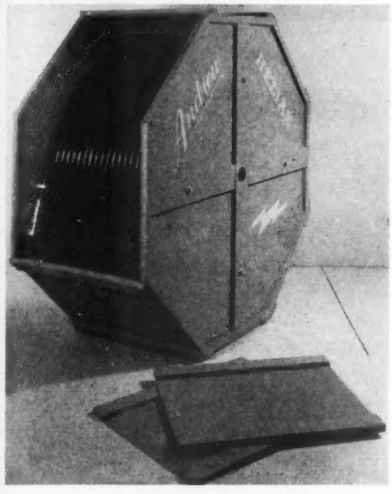

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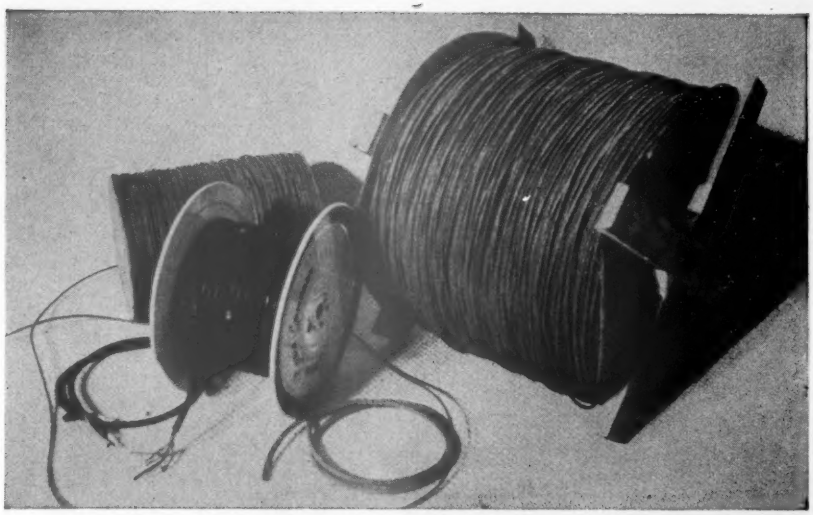

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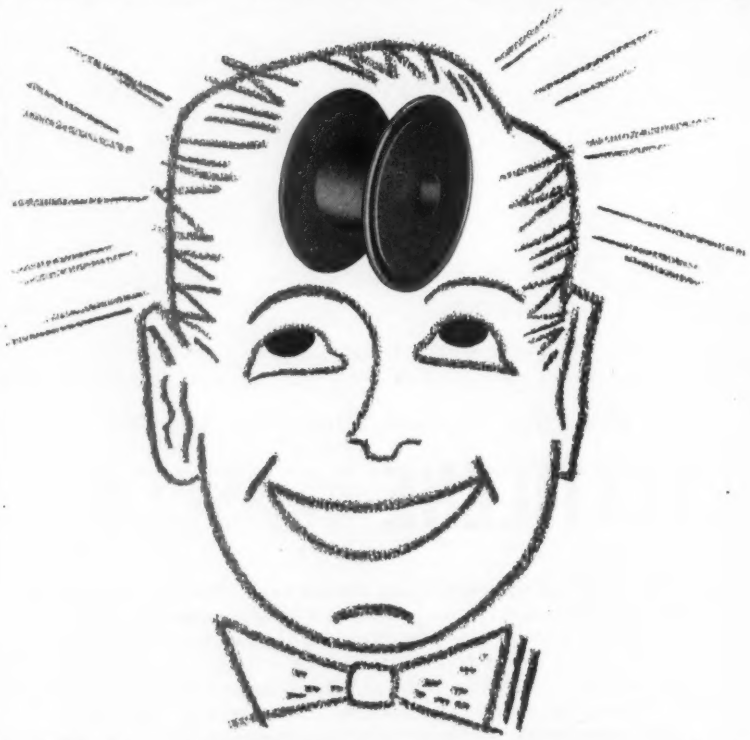

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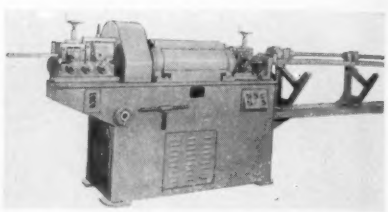

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**"Protective** Maintenance of Motors and Generators," an authoritative 63-page booklet intended primarily for the use of maintenance men in the electrical industry, but of interest as well to engineering students and others concerned with motor and generator problems, has been produced by the Renewal Parts Section of the **National Electrical Manufacturers Association.** This has been announced by **John Drollinger,** Chairman of the Section's Information Committee, and Manager, Renewal Parts and Repair Division, **Reliance Electric and Engineering Co.,** Cleveland, Ohio.

* * *

**Included** in the booklet is an appendix containing NEMA Standards for Classification of Coils, Insulating Materials, Replacement Commutators and Assembled Segments, Authorized Engineering Information on Armature Winding Supplies, Guides for Maintaining Continuous Operation of Motors and Generators, Preservation of Renewal Parts for Electrical Ro-

tating Apparatus, and proposed Definitions of Renewal Parts.

* * *

**Individual** copies may be obtained without charge from NEMA Headquarters, 155 East 44th Street, New York 17, N. Y. Quantity copies may be purchased from NEMA at bulk rates.

## Wirebound Boxes Go Academic

**Though** the modern school has much to boast of in the way of beautiful and up-to-date equipment, it still finds much of value in materials brought in from other sources. In this category, the wirebound box and crate serve well. And in a surprising number of ways!

* * *

**Because** of their sturdiness, the wirebound boxes take the handling given by many children. Their unique shape and size make

Fig. 1 Toy Chest * * * * * * *

possible many profitable living and learning activities. Taken apart, durable strips become "picture frames" and counting sticks. They take varnish and paint well. Often they are cages for imaginary or real animals for plays and science observation. Even in arithmetic lessons, they serve. For rectangular and cubical measurements they are used, affording valuable problem practice.

* * *

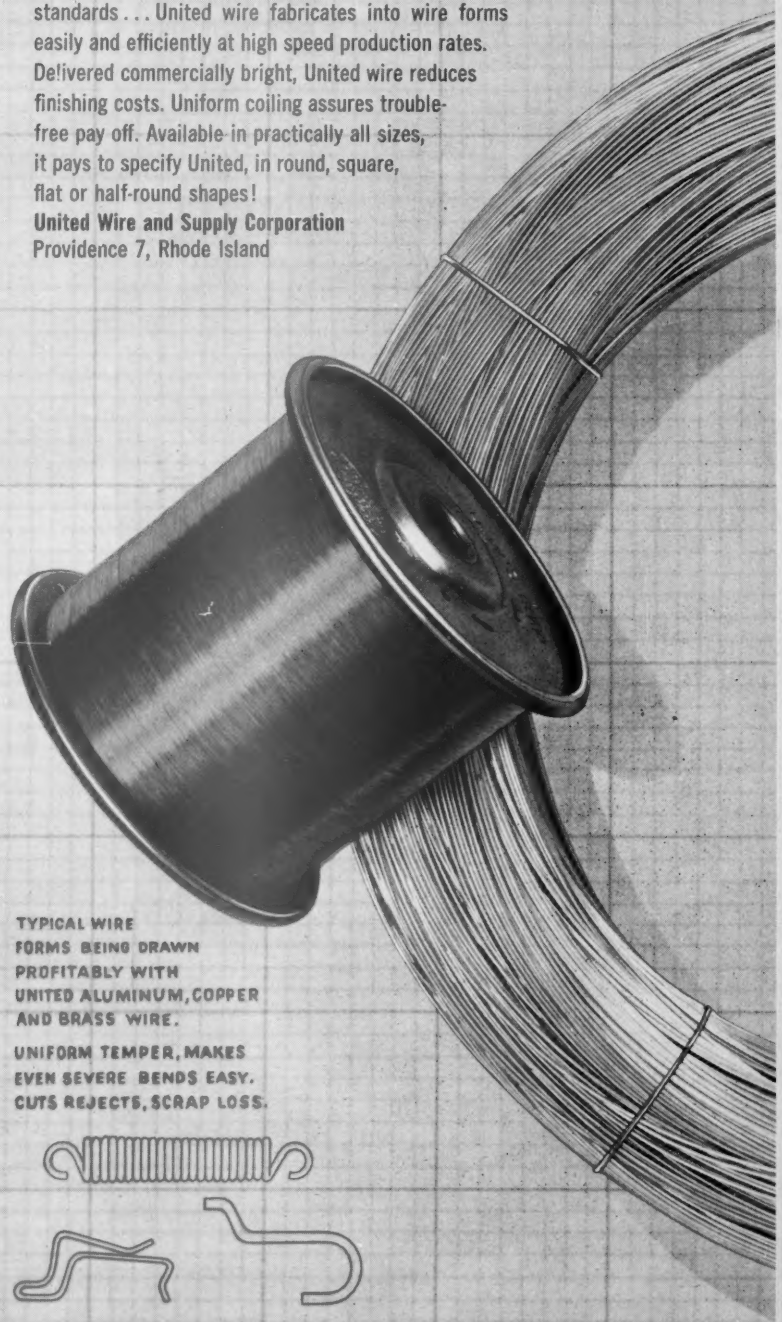
**Wirebound** boxes and crates can be stood upright for display cases for science objects and collections. They hold hobby exhibits, and "doll house" displays. Their lids remain to serve as protection while the exhibits are "on the move." Lengthwise, in its own familiar horizontal position, the wirebound crate is fine as a storage toy chest, as there seems never


TOLERANCE

Reason why — it Pays to Specify
**United** Aluminum, Brass and Copper **Wire**

Drawn or shaped to your most exacting tolerance and temper standards . . . United wire fabricates into wire forms easily and efficiently at high speed production rates. Delivered commercially bright, United wire reduces finishing costs. Uniform coiling assures trouble-free pay off. Available in practically all sizes, it pays to specify United, in round, square, flat or half-round shapes!

**United Wire and Supply Corporation**
Providence 7, Rhode Island



TYPICAL WIRE FORMS BEING DRAWN PROFITABLY WITH UNITED ALUMINUM, COPPER AND BRASS WIRE.

UNIFORM TEMPER, MAKES EVEN SEVERE BENDS EASY. CUTS REJECTS, SCRAP LOSS.



For aluminum, brass and copper wire and tube
For silver brazing alloys . . . always **Specify**

UNITED

# WARDWELLIAN®

## PAPER SERVER —TYPE "C"

STANDARD EQUIPMENT

Another in the outstanding series of Wardwell serving machines. This machine is designed to serve four ends of flat paper to electrical conductor for the production of Non-Metallic Sheathed Cable.

Paper passes through a die located at serving point, thereby producing a product with a firm, smooth finish and of uniform diameter over its entire length.

## "WARDWELLIAN" Paper Server *General Features*

- Machine is equipped with electric stop-motion.
- Production dependent upon requirements. Will produce 1407 feet per hour when machine is applying material at 10.6 turns per foot.
- Standard set of twelve change gears furnished with each machine.
- Serving head speed 250 RPM.
- Driving pulley 8" diameter; 1¾" belt. Speed 575 RPM.
- Ratio pulley speed to serving head speed 2.3 to 1.
- Capstan 18" diameter, 3" face.
- Opening through serving head ⅝" diameter.
- Supply packages 14" diameter, 1½" hole; paper up to 1½" wide, .003" thick.
- Maximum power requirements .6 HP including power transmission equipment.
- Motor drive can be furnished upon request.
- Stands can be furnished to accommodate reel 30 inches in diameter with overall widths up to 16 inches.
- Special windup driving parts required for reels with drums under 8" diameter.
- Reels are not included with machine.
- Weight approximately 508 lbs.
- Weight crated for domestic shipment approximately 615 lbs.

Counter for measuring product in feet or yards furnished upon request.

There are nearly thirty different applications for Wardwell equipment, including Braiding, Shielding with wire, Tape Serving, Yarn Serving, Asbestos Serving, Paper Serving, Armor Serving and Resistance Wire Serving.

REPRESENTATIVES FOR EUROPE, BRITISH COLONIES AND DEPENDENCIES
JAMES MACKIE & SONS, LTD.
BELFAST, IRELAND

*Wardwell*
BRAIDING MACHINE CO.
CENTRAL FALLS, RHODE ISLAND, U.S.A.

133-9


to be quite enough storage space, even in the most modern classroom!

* * *

**For** creative and dramatic plays, tots in the lower grades use the boxes for imaginary autos, trains, space ships, and cars. The circus study finds a number of them together for a "circus train."

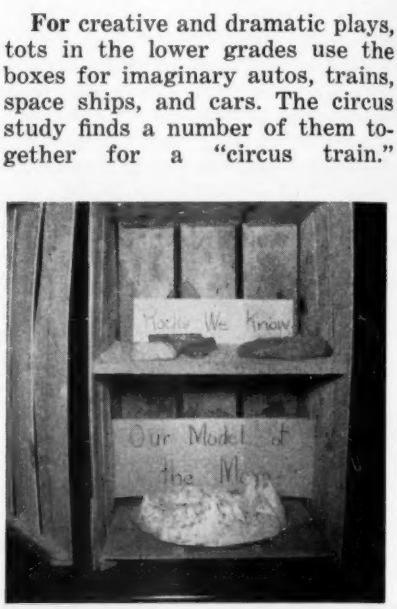



Fig. 2 Science display case * * * * *

Though sturdy, they are light enough to be handled, in athletic "box relays", too. The box is often changed to a colorful piece with wallpaper, paint and other decorations. Children handle them much as they would handle huge building blocks.

* * *

**Cut** in half, with a small entrance-doorway added, the wire-bound box becomes a nice pet bed. And, teachers often file large charts, mounted pictures, and pupils' individual record folders in them. Ideal individual group "library cabinets" for little books are made from the upright wire-

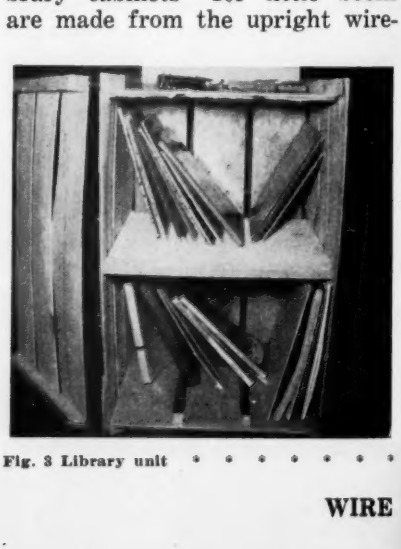


Fig. 3 Library unit * * * * * * * *

bound crates. Sometimes the wires serve as models, mobiles, art forms, etc.

* * *

**Neighborhood** grocers often are alerted to "save" the wirebound crates and boxes for the local school children. It is not surprising, then, that they have joined the modern academic scene, and serve in many unique ways!

---

Ed Note: This is published because it is the wire that has given these boxes their utility in the classroom.

### Wire Mill Expanding

**The Maryland Fine & Specialty Wire Co. Inc.,** Cockeysville, Md., has started the erection of a 7200 square foot plant addition and a 3000 square foot office facility. The present offiice area of about 5000 square feet will be converted for manufacturing purposes. Construction was begun in August.

### Sunbeam Furnace Appointments

**Sunbeam Equipment Corporation,** Meadville, Pa., recently appointed the following companies to represent its line of industrial furnace equipment: **Southwestern Engineering & Equipment Company,** 4045 Lemmon Ave., Dallas, Texas; **Harrison Engineering Corporation,** P. O. Box 4784, Detroit, Michigan; **W. L. Ekland Company,** 7871 W. 46th Ave., Wheat Ridge, Col.; and **Gerald B. Duff & Co.,** 2165 Morris Ave., Union, N. J.

### Diamond Dust Moves to New Plant

**Formerly** located in Glendale, L. I., **Diamond Dust Co., Inc.** is now located at 77 Searing Avenue, Mineola, L. I., N. Y. This 7,500 square foot plant is a modern 1-story laboratory, with all the Dia-Dusco laboratory services, manufacturing and reclamation under one roof. This includes the manufacture of virgin diamond powder, virgin diamond compound, processing of borts and reclamation. All Dia-Dusco products conform to both the U. S. Bureau of Standards, and the Military Specs. (MIL-C-16195), as to purity, uniformity, and sizing.

* * *

**The** company is setting up a


## *EFFICIENT, MODERN SYSTEMS FOR ELECTRICAL WIRE & CABLE MANUFACTURING*

• ***CABLE LACQUERING SYSTEMS***

**Conventional cellulosic, or other type, lacquers are applied in successive continuous coats from one to twenty-eight coats over fibrous braid wrapped primary conductors. One end, four ends, or eight ends of wire are handled continuously. System includes letoff, application, drying and constant tension takeup equipment.**

• ***WIRE ENAMELING SYSTEMS***

**Natural and synthetic enamels, silicones, solution nylon, modified plastisol, and similar insulating coatings are applied to bare, cotton or glass covered wire in round, square or rectangular cross section. Ten or twenty simultaneous strands are handled. Systems are complete with letoff, preannealer, application system, capstan and multiple takeup unit.**

• ***ASBESTOS INSULATING SYSTEMS***

**Carded asbestos is applied to continuous single conductor as an integrated operation with saturating, rotary forming, drying, cooling and polishing of the finished wire. Wire from No. 20 gauge to No. 6 AWG is handled through an asbestos wall thickness range of from .008″ to .040″ thickness in a single pass.**

• ***RUBBER OR PLASTIC JACKETING SYSTEMS***

**Rubber and thermoplastic jacketing compounds are continuously applied to electrical wire or cable by the extrusion method. High speed, constant tension letoff and takeup equipment, controlled cooling or continuous vulcanizing equipment are powered by synchronized range drives as complete, integrated wire handling systems. Extrusion machines of customer's choice are furnished.**

• ***GLASS & VARNISH COATING SYSTEMS***

**Double layer of glass or cotton wrapping is applied to round, flat or square conductor. Two individual coatings of high temperature varnish are applied and the finish baked in a continuous operation. Units are complete from letoffs to takeup frames.**

• ***SELF TRAVERSING REEL CORD DRYERS***

**These ingenious machines are used to remove hygroscopic moisture from fibers, braided or knitted flexible cable. These machines increase extrusion speeds, reduce blister scrap loss and improve diameter control. They are easily installed in existing extrusion line.**

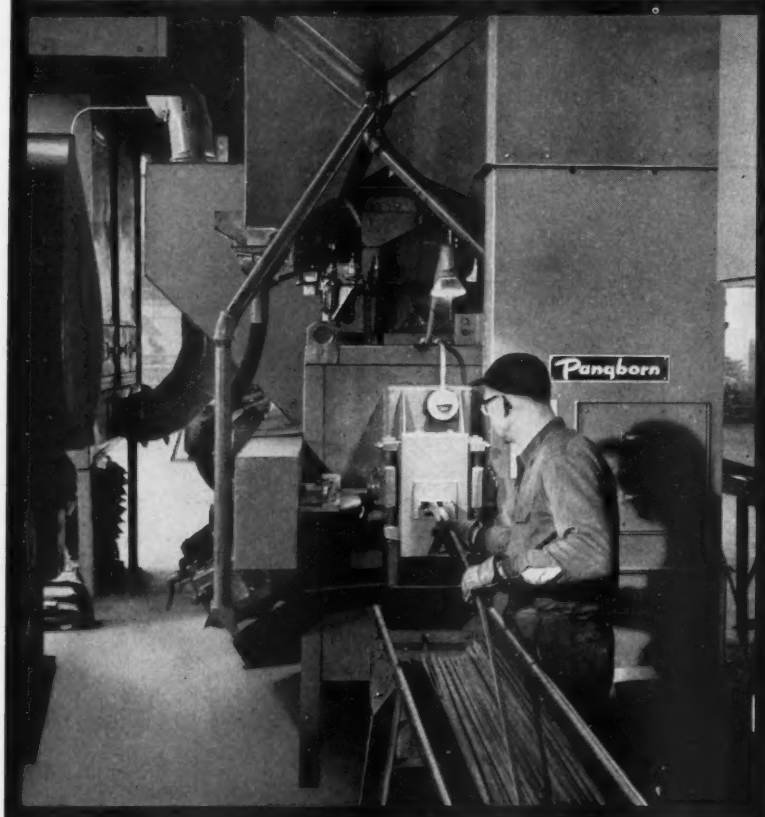
***TECHNICAL INFORMATION ON ANY OF THESE PROCESSES UPON REQUEST***

## *C. A. LITZLER CO., INC.*

**235-239 BROOKPARK ROAD**

**CLEVELAND 9, OHIO**

# ROTOBLAST DESCALING SAVES $75 A DAY




**Pangborn Rotoblast Descaling Machine makes cost-cutting automation possible at Bustin Steel**

At Bustin Steel Co., Dover, N. J., hot rolled steel bars are descaled by a Pangborn Rotoblast Machine at rates up to 180 linear feet per minute. This speed of operation plus the perfect quality of work—eliminating oiling and degreasing operations later—permits inserting this Rotoblast Machine directly at the head of the production line, working toward a completely automatic manufacturing operation.

The operating cost of this machine saves Bustin at least $75 a day compared to pickling, *plus* the cost of degreasing *plus* savings resulting from longer tool and die life.

For information on how Pangborn Rotoblast can save *you* money, write PANGBORN CORP., 5400 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Blast Cleaning and Dust Control Equipment and Rotoblast Steel Shot and Grit.*

**Pangborn** CLEANS IT FAST WITH **ROTOBLAST**®


service bureau to give advice and assistance to industry on lapping and polishing. Write to the attention of "Service Bureau" when sending queries.

### Steelskin's 50th Anniversary Observed at Convention

As part of the celebration of its 50th Anniversary at The Annual Covention of The Wire Association in Cleveland, **The R. H. Miller Company,** Homer, New York, manufacturers of "Steelskin" lubricants, gave a series of prizes to those who attended their headquarters.

* * *

**The** 50th Anniversary Clock, the grand prize was won by **Mrs. Allan B. Dove,** wife of The Association president. Since the rules required that the person be present during the drawing, consolation prizes were sent to **Mrs. John McHugh** and **Messrs. Walter McShane, Michael Sarenshaw** and **R. C. Peterson.** Their names were drawn, but they were not there to receive the clock.

* * *

**Door** prizes were distributed by drawing at midnight, October 14, the winners being:

***Copper Chafing Dish***
**Mrs. James Van Horn, Detroit Steel**

***Jewel Box***
**P. Raffensberger, Bethlehem Steel**

***Stadium Robe***
**Albert P. Cote, Detroit Steel**

***Cashmere Muggler***
**R. J. Applegate, Roebling's**

***Cocktail Shaker***
**Walter Saunders, Chicago Steel & Wire**

***Tie Rack***
**Albert Johnson, Roebling's**

***Bottle Opener***
**Mrs. John Sanderson, Keystone Steel & Wire**

***Tie***
**Mrs. Earl Shepherd, Republic Steel**

***Cuff Links***
**L. G. Dewberry, Jr., Atlantic Steel**

***Gourmet Set***
**Miss Jane Rigo, American Steel & Wire**

***Jewel Box***
**William Gagnon, New Departure**

***Tie***
**Ralph Clapp, Wire Sales**

***Tie***
**John Greenaway, Johnson Steel & Wire**


**Get the habit of reading regularly**
**WIRE AND WIRE PRODUCTS**
**The Wire Man's Magazine**

# Outstanding Personalities of the Wire Industry

### Davis-Standard Appoints Sales Engineer

**Rodney H. Morrison** has been appointed as Sales Engineer for **Davis-Standard, Div. of Franklin Research Corp.**, Mystic, Conn. The appointment is effective immediately.

* * *

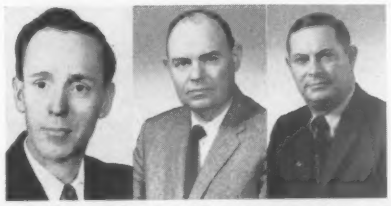
**He** will handle Davis-Standard Thermatic Extruders for thermoplastic and rubber and accessory equipment to general extrusion accounts exclusive of wire insulating business. His sales territory extends from Long Island and metropolitan New York City through New Jersey, Pennsylvania, Delaware, Maryland, the Virginias and North and South Carolina.

* * *

**Mr. Morrison** has had extensive experience in the plastics field with the DuPont Polychemicals Division and with the Celanese Corporation of America. He has a B. S. Degree in Chemistry from Ohio State University.

### Lee Wilson Engineers Promoted

**Lee Wilson Engineering Co., Inc.**, Cleveland, has made three important personnel changes in their engineering division, it was announced recently by **J. L. Whitten**, Vice President.



L. to R.: John Arnold, Robert H. Hill and Robert J. Beemer.

**John Arnold**, formerly Chief Engineer, has been promoted to the new position of Manager of Engineering and New Products.

* * *

**Robert R. Hill**, formerly an assistant to Mr. Arnold, has been given the position of Chief Engineer.

* * *

**Robert J. Beemer**, formerly an engineer in the Research and Development Department, has been named to assist Mr. Hill as Assistant Chief Engineer.

### Niehoff Representative Arrives for Extended Visit

**Siegfried Schroeder**, of **Niehoff Machine Works**, Western Germany, manufacturers of Wire Drawing Units for steel wire, has just arrived in the United States for an extended visit.

* * *

**Mr. Schroeder**, who is an expert on the manufacturing of wire, was sent over by Niehoff to assist manufacturers in this country who may need help in smoothing out production difficulties. He is making his headquarters at the offices of **American Laubscher**

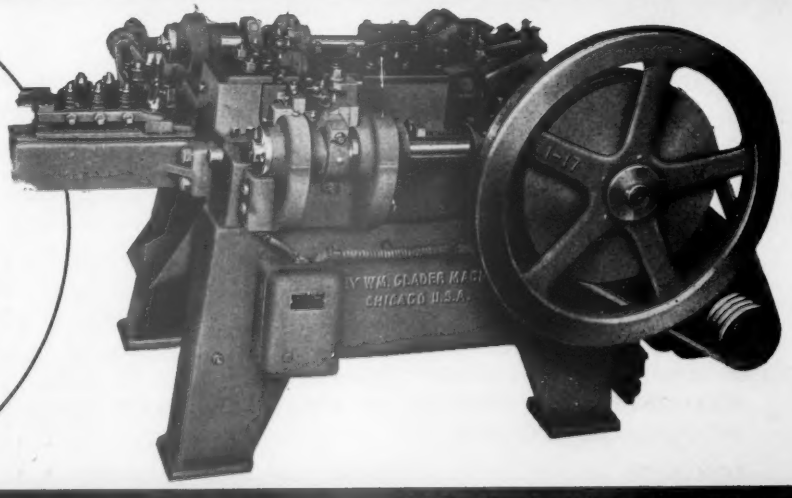

GLADER

HIGH SPEED WIRE NAIL MACHINES

HIGH TONNAGE OUTPUT—LOW MAINTENANCE COST

You can take care of increased production schedules and better product demands with these machines of established reputation.

For 55 years GLADER MACHINES have been giving HIGH QUALITY, LOW COST nail production.



Wm. Glader Machine Works 210 N. Racine Avenue Chicago 7, Illinois

Export Dept. 122 East 42nd Street -:- New York 17, N. Y.

Corp., 250 West 57 Street, New York City, exclusive representatives for Niehoff in the U.S.A. and Canada.

### Crucible Appoints Field Service Representatives

**Curtis R. Pardee** and **E. F. Anderson** have been appointed Field Service Metallurgists by the **Crucible Steel Company of America.** Mr. Pardee has been assigned to the East Central Region, and Mr. Anderson to the New England and Eastern Regions.

**Mr. Pardee,** formerly Product Service Engineer at the Company's Cleveland Branch, will make his office in Solon, Ohio. Mr. Anderson, whose offices will be in Caldwell, N. J., was formerly District Manager of Pittsburgh Crucible Products in the New York-New England territory.

### National-Standard Appoints Representative

**Kenneth Z. Zonsius** has been named to represent the **National-Standard Company,** a principal supplier of wire products and machinery to the rubber industry, according to **William D. Peace,** vice president for rubber industry sales. Mr. Zonsius will be based in Akron, Ohio, and will cover the rubber industry in Ohio and Western Pennsylvania. Mr. Zonsius is a graduate of Harvard University.

### To Market Wire Screening

**A. C. Van Roden, Jr.,** has joined the sales department of **New York Wire Clothing Company,** York, Pa., to direct the marketing of "Opal" insect wire screening, according to **W. F. Sewert,** sales manager.

* * *

**Mr. Van Roden** was formerly a product director of Chicopee Mills, Inc., New York City, and has been engaged in other sales-merchandising capacities, primarily in hardware and window products lines.

### Textile Machine Elects Research Head

**The** Board of Directors of **Textile Machine Works,** through its chairman, **Louis R. Thun,** has announced that **Kenith Strunk** has been elected to fill the newly created post of Vice President of Research and Engineering at its Wyomissing plant. Mr. Strunk is a graduate of the University of Michigan.

* * *

**In** addition to being responsible for the coordination of all engineering operations, in which he will be assisted by Textile's chief engineer, **G. Bitzer,** Mr. Strunk will utilize his wide experience in the field of research by being particularly active in and responsible for new product development at Textile.

### Harper Electric Adds To Sales Staff

**James R. Robertson** has joined the sales staff of **Harper Electric Furnace Corporation,** Buffalo, N. Y. In his new post, he will direct the expansion of Harper activities in marketing gas-fired heat treating and non-ferrous melting furnaces.

* * *

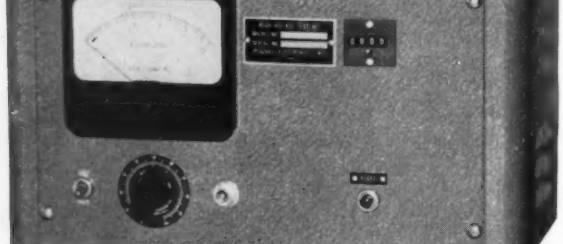
**For** the past several years, Mr. Robertson has been engaged in this phase of the furnace industry


The PESCHEL line

ELECTRICAL TEST EQUIPMENT FOR THE Wire Industry

Low Cost-High Quality Sparker

Now- GUARANTEED FOR 5 YEARS



Model S14CV — AC/DC

FEATURES: RUGGED CONSTRUCTION WITH LONG LIFE SELENIUM RECTIFIERS • ACCURATE AT ANY SPEED • DC OR AC OUTPUT • FOR USE ON EXTRUDER OR RESPOOLER. ANY SPEED • 400 FPM WITH 1" ELECTRODE (2400 FPM WITH 6" ELECTRODE) • RELIABLE OPERATION DOWN TO 5% OF MAXIMUM OUTPUT VOLTAGE • SIMPLE TO OPERATE BY INEXPERIENCED PERSONNEL.

FOR BEST VALUE — SPECIFY PESCHEL SPARKERS

PE PESCHEL ELECTRONICS, INC.

TOWNERS, NEW YORK (Putnam County) Tel: TRinity 8-3251

as president and general manager of Wayne Industrial Furnace Company. He is an electrical engineering graduate of the University of Michigan.

* * *

**Harper** Electric Furnace also manufactures a complete line of electric furnaces for brazing, sintering, wire annealing, bright annealing and forging as well as electric kilns for a wide variety of applications, with general offices at 110 Pearl St., Buffalo 2, N. Y.

### Named Wire Rope Sales Manager

**George C. Jennings** has been named Wire Rope Sales Manager of **The Colorado Fuel and Iron Corporation, F. S. Jones,** CF&I vice president in charge of sales, has announced. Formerly the company's New York District Sales Manager, he will now be headquartered at the Palmer, Mass., plant.

* * *

**He** joined CF&I in 1946 as the Buffalo District wire rope sales correspondent for the company's Wickwire Spencer Steel Division, and has worked in various sales capacities since then. He succeeds **A. S. Rairden** at Palmer, who has been made works manager.

### Chester Cable Appoints Superintendent

**Chester Cable Corporation,** Chester, N. Y., has announced the appointment of **James Henderson** of Hamburg, N. J., as Plant Superintendent, where he had been purchasing agent and production manager at Chester Cable since joining the company in 1956. He has been connected with wire and cable for the past 12 years, in various phases of production control and purchasing operations.

* * *

**Aside** from playing a fair game of golf, Jim's outside activities are centered in the education field, where he has grappled with the problems of the modern public school system for the past two years as president of his local school board.

### Named Works Manager of Chase Mill in Cleveland

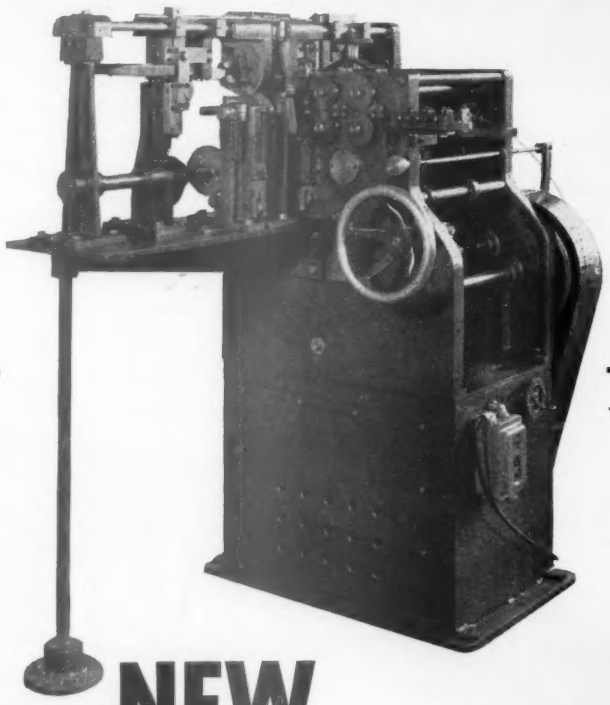
**Appointment** of **Paul R. Totten,** as works manager of the Cleveland Mill Division of **Chase Brass & Copper Co.** was announced by **Gilbert R. Boutin,** vice president-operations for Chase. The appointment became effective Oct. 1.

* * *

**Mr. Totten,** who succeeds the late **Howard C. Walters,** is a native of Wooster, Ohio, and comes to Chase from the Allenport Works of **Pittsburgh Steel Company,** where he has been divisional superintendent for the past 4½ years.

* * *

**He** is a graduate of College of Wooster, Wooster, Ohio, with a B.A. degree in Chemistry, and of Ohio State University, with a Master of Science degree in Metallurgy.

**NEW** For Springmakers

AUTOMATIC COILER and LOOPER

**WELLS' NEW FULLY AUTOMATIC SPRING COILING AND LOOPING MACHINE** coils, trims and loops in sequence. By trimming before looping extremely accurate springs are made. Produces cross-over, machine and side loops, or any combination of these.

Machine shown above handles .025" to .062" diameter wire, forming coils of 3/16" o.d. to 5/8" o.d., 1/2" to 5" long.

Loops on each end can be varied 360° to each other and held to ±3°. Loop openings can be held to ±.010", or less.

Adapted from the WELLS large diameter automatic coiling and looping machines made for several years, this new spring machine will be a boom to manufacturers of mechanical coil springs.

Made By The Producers of the Wells Straightening And Cutting Machines.

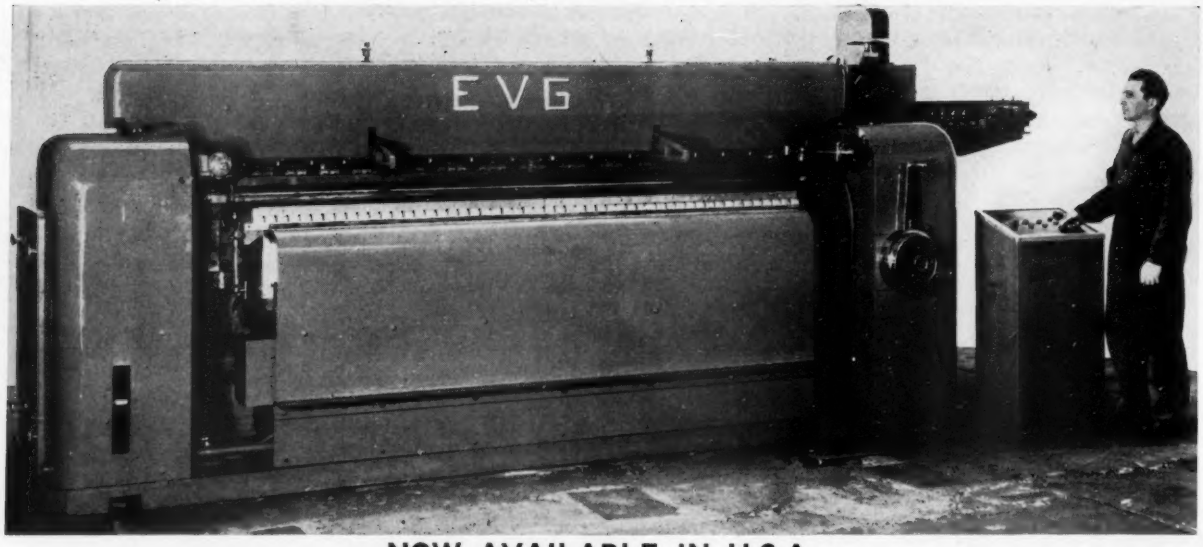
Write for information

*Frank L. Wells Company*

BUILDERS OF FINE WIREWORKING MACHINERY

5821 FIFTH AVENUE • KENOSHA, WISCONSIN

OR — HARVEY SPRING MFG. CO. — 671 N. Sangamon St., Chicago, Ill.




## NOW AVAILABLE IN U.S.A.

### COMPLETE LINE OF WIRE FABRIC WELDING PLANTS, Tailored To Fit Every Need From The Heaviest To Lightest

Bringing tremendous advantages over other welders, EVG's line of wire fabric welding plants offers increased versatility and profit to American mesh manufacturers. (Shown in photograph above is EVG's Standard Duty model G5 with a working range of 4/0 to 10 gauge.) All EVG wire fabric welding plants feature the latest type automatic feeding, straightening and cutting devices, full electronic controls and adjustments for pressure, heat and dwell. Fabric changeover is economic and speedy. Available in five base models — fine-wire, light, standard, medium and heavy-duty. No waste capacity — great savings in capital investment and floor space reduction.

**Available for inspection in actual production in U.S.A. and Canada. Direct inquiries to Richard E. Kleinhans, 122 East 42nd Street, New York, New York, OXford 7-0770.**

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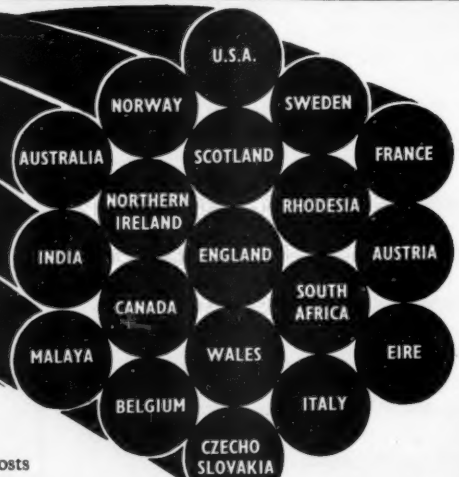
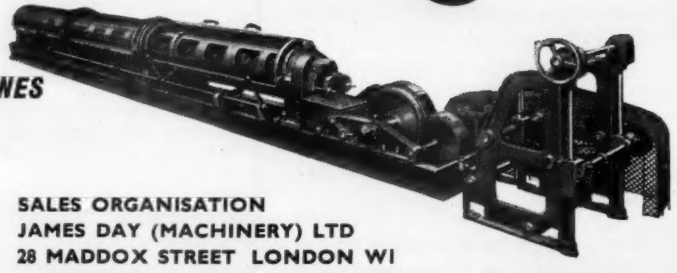
# world wide sales...




. . . indicate a world-wide reputation. Hanson & Edwards have supplied High Speed Tubular Stranding Machines to many of the most important Wire Rope and Cable factories throughout the world. These machines have rotors which run in large SPLIT ROLLER BEARINGS, not on support rollers, giving higher speeds, smoother running and lower maintenance costs

***ROLLER BEARING TYPE HIGH SPEED TUBULAR STRANDING MACHINES***

*Made in various sizes for reels from 5"x 2½" up to 24"x 12" Write now for details*



**HANSON & EDWARDS LTD**

***WARRINGTON ENGLAND***

**SALES ORGANISATION**
**JAMES DAY (MACHINERY) LTD**
**28 MADDOX STREET LONDON W1**

**U.S. AGENTS:—THE EDMANDS COMPANY 860 WELLINGTON AVENUE CRANSTON 10, R.I.**

P2035

### Durant Appoints New Sales Manager

**James K. McGinley** has been appointed General Sales Manager of **Durant Manufacturing Company** of Milwaukee, Wisconsin, it was announced by **W. W. Winkler, President.**

* * *

**He** joined Durant as a salesman in 1946 and later became district sales manager. In 1953 he was named regional sales manager of the Central and Southern areas of the United States. In his new position, Mr. McGinley will direct Durant's thirty-three sales offices in the United States, as well as the nineteen foreign sales offices.

* * *

**Durant** Manufacturing Company was established in 1879 and is a leading manufacturer of production counters for general industry. In recent years the company has added a full line of electric and mechanical instrument counters used for data readout in navigation, computer and test instrument fields.

James K. McGinley

* * *

**Durant** has tripled its production in the past seven years, and in 1957 a new plant was built in Watertown, Wisconsin, to manufacture these instrument counters exclusively.

### SKF Appointments

**SKF Industries, Inc.** has announced the appointment of **Thomas W. Morrison** as director of Research and engineering and of **Bruce M. Smith** as chief industrial engineer.

* * *

**In** his new post Mr. Morrison takes over active direction of the Engineering Division and the Research Laboratory. He studied at Temple University and La Salle College and is a graduate mechanical engineer of Drexel Institute of Technology. He joined SKF in 1936 and replaces Vice President **Gunnar Palmgren,** who has retired.

* * *

**Mr. Smith** fills a position left vacant by **Stuart J. Northrup,** who now is Mechanical Superintendent. He will be responsible for the administration of industrial policies and procedures. He studied at Iowa and Northeastern Universities and graduated from Purdue.

### Heads N. E. Spring Manufacturers

**Frederick R. Downs, Jr.,** sales manager for **Stanley-Humason, Inc.** of Forestville, Conn., a sub-


FASTER PRODUCTION LOWER COSTS A SNAP!

UL APPROVED

Electrix SEPARABLE PLUGS

You build better cord sets . . . faster and at lowest cost per finished unit with ELECTRIX Separable Plugs. Even more important, you get high quality, because ELECTRIX Separable Plugs have great holding power, a finer finished appearance, and pass the most rigid in-use tests.

Assembly is easy with the time-proven Electrix Automatic Attaching Machine.

Write for complete information.

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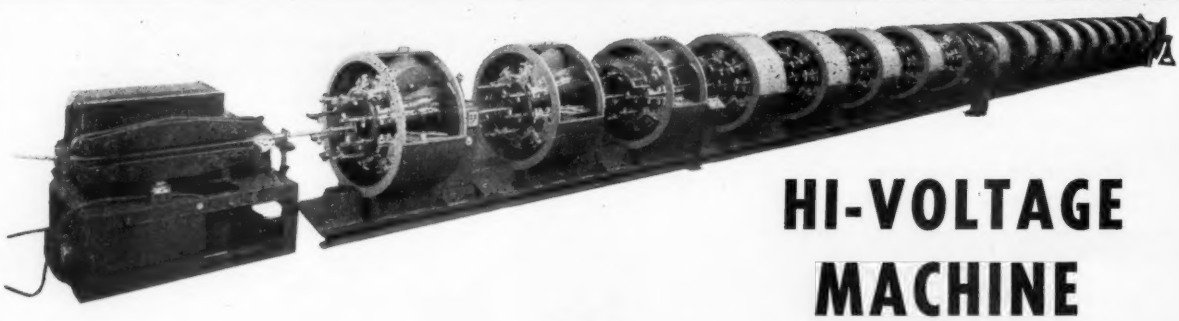

# HI-VOLTAGE MACHINE

300 K.V.

- 296 Papers.
- 6 20 Paper Heads, 16" Pad.
- 11 16 Paper Heads, 20" Pad.
- Q.B. Type Caterpillar Haul-off, Maillefer Patent.
- Lay Adjusted by P.I.V. Driving Each Head and P.I.V. on Caterpillar.
- Total Length of Equipment for 296 Papers, Including Caterpillar, but Exclusive of Let-off and Take-up: 118'.

## POURTIER Machines

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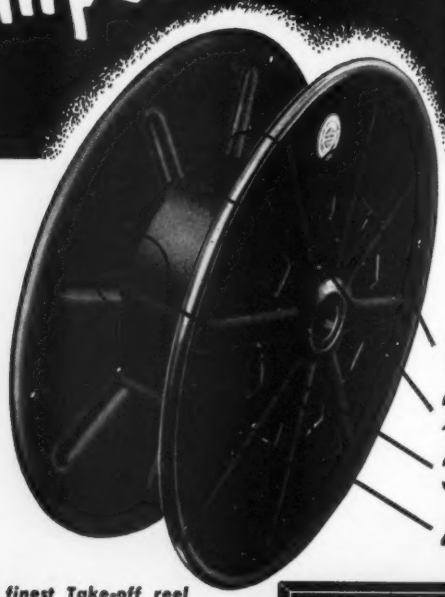
# Important DIFFERENCES

BETWEEN JUST ANY REEL AND *All Welded* MPS



## TAKE-OFF REELS

**Three important differences that mean longer reel life in both processing and handling of all types of insulated wires in your plant.**

1. **New MPS deep wide, straight type embossed radial rib** adds considerable strength to reel heads over the old style narrow tapered rib.
2. **Increased height of the curled edge** adds even more strength and rigidity, especially to the rims.
3. Furnished with **rib fillers** that are projections on the end of the barrels that fit into the embossed radial ribs thereby **eliminating any marking of the plastic or rubber insulated wires** at the junction of head-barrel.
4. Finally, the **all welded "J" type construction** of the entire reel completes the picture.

***The finest Take-off reel you can buy.***
We invite your inquiries — let us tell you more about MPS Take-off Reels. Write us today.

*Mossberg* PRESSED STEEL *Corporation*

"Division of Wanskuck Co."
18 West Street — Attleboro
Massachusetts U.S.A.
Telephone Attleboro 1-0848
#109

sidiary of The Stanley Works, was elected president of the New England Group of Spring Manufacturers at its annual meeting held in Bristol, Conn. (October 22, 1959). The organization is affiliated with the National Spring Manufacturers Association, Inc.

### Heads Firth Sterling Steel Division

**R. K. Hopkins** has been appointed vice president and general manager of the Steel Division of **Firth Sterling, Inc.** According to **Kenneth D. Mann,** president, this completes the separation of the Company into two semi-autonomous divisions, namely, Steel and Carbide.

* * *

**J. T. O'Brien** remains operating vice president of the Steel Division, responsible to Mr. Hopkins for all aspects of production, and **J. S. Roller** continues as vice president of sales, responsible to Mr. Hopkins for commercial activities. Thus, Mr. Hopkins' responsibilities will consist primarily of integration and coordination of sales and production efforts, while at the same time retaining the major responsibility of developing the Hopkins Process operationally, metallurgically and commercially.

* * *

**T. G. Barnes** is vice president and general manager of the Carbide Division.

### To Represent Torrington Mfg. in Cleveland

**Ernest V. Collins** has been appointed Cleveland sales representative for the Machine Division of **The Torrington Manufacturing Co.,** Torrington, Conn., producer of wire-forming equipment, rolling mills, and Verti-Slide machines. He will cover Ohio, northern New York state, and western Pennsylvania from the company's office at 3537 Lee Road, Cleveland.

* * *

**Mr. Collins** studied mechanical engineering at Connecticut State University and then was graduated from Pratt & Whitney's engineering training school. He will be responsible for all Machine Division sales and engineering services in the area.

### Anaconda Elects New President

**Richard B. Steinmetz** has been elected president of the **Anaconda Wire & Cable Company,** New York, to replace **William E. Sprackling,** retired.

* * *

**Mr. Steinmetz** has been associated with the firm since 1929 and had been its executive vice-president. Mr. Sprackling will continue his affiliation with the company as a director.

* * *

At the same time it was announced that **William H. Benton,** general manager of mills, has been elected to the board of directors.

### Crucible Appointments in Titanium Division

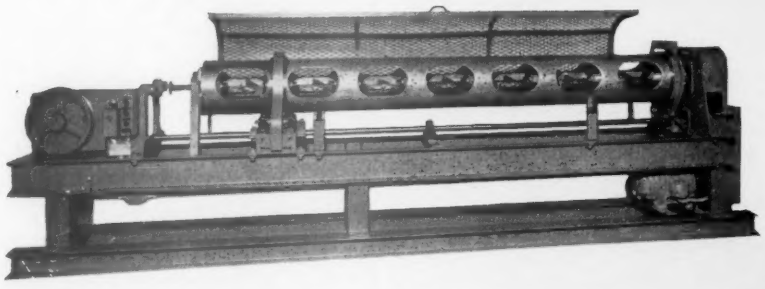
**Everett E. Cox** has been appointed Division Superintendent—Titanium at the **Crucible Steel Company's Midland Works.** Replacing Mr. Cox as Superintendent of Production at the Titanium Di-


SEVEN BAY
HIGH SPEED
STRANDER

MODEL 7 B 55

This precision, perfectly balanced machine features: rigid steel box structure-barrels of high strength ALCOA alloy — motor mounted below center of gravity — safe, positive drive — push button controls— carbide wire guides — interchangeable cradle assemblies — standard cradles taking 7" diam. X 4" Traverse Spools — 30 lengths of lay.

BARTELL FOR THE BEST



• CATERPILLAR CAPSTANS • SINGLE & MULTIPLE HEAD RESPOOLERS • WIRE STRANDERS
• TAKE-UP & PAY-OFF STANDS FOR PLATING EQUIPMENT

BARTELL MACHINE-TOOL CORP.
YACHT CLUB ROAD ROME, N. Y.
• DESIGNERS • MANUFACTURERS • ENGINEERS • CONSULTANTS

WE ALSO DESIGN AND BUILD SPECIAL EQUIPMENT TO MEET SPECIFIED REQUIREMENTS

vision is **Jay J. Patten,** who was formerly the Assistant Superintendent.

* * *

**Mr. Cox** was graduated from North Dakota University in 1938 with a B. S. degree in Business Administration. He also attended Winona Teachers College in Winona, Minn.

* * *

**Mr. Patten** attended a business college in Ft. Madison, Iowa, and studied Traffic Management courses at LaSalle University Extension Division in Chicago.

### Joins Great American Plastics

**Irwin Cohn,** president of Great American Plastics Company, Fitchburg, Mass., manufacturers of the Irvinil line of plastics, has announced the appointment of **John E. Beaumont** to the sales department of the Poly Vinyl Chloride — Irvinil Division of the company.

**Mr. Beaumont,** well-known in the plastics industry, was formerly with the Bakelite Corporation and the Carlon Products Corporation.

### Crucible Steel Shifts

**Eugene A. March** has been appointed Assistant Works Manager at **Crucible Steele Company's** Midland plant. His vacated position as Division Superintendent of Technical Services will be filled by **Guy F. McCracken,** Chief Control Metallurgist at Midland.

* * *

**Mr. March** joined Crucible in 1946 as Metallurgist — Mill Control at the Company's Sanderson-Halcomb Works in Syracuse, N. Y. He has held a number of positions prior to this appointment.

* * *

**Mr. McCracken** has been with Crucible since 1949 when he was appointed Metallurgist at the Company's Sanderson-Halcomb Works in Syracuse, N. Y. He was transferred to Midland last January.

### Carpenter Steel Appointments

**Donald F. Ross** has been promoted by **Carpenter Steel Co.,** Reading, Pa. to Dayton-Cincinnati district manager and **Richard Boyd** to the same position in Atlanta, Ga. Both men have been with the company for a number of years in various sales capacities.

### Ernest Theodore Laubscher

**Ernest Theodore Laubscher** of 123 West Fifty Seventh Street, president of the **American Laubscher Corporation,** automatic screw machine products agency at 250 West Fifty-seventh Street, died on October 7, 1959, in Dallas, Texas, at the age of seventy-seven.

* * *

**The** American Laubscher Corporation, successor to a sales organization he founded here in 1945, represents Laubscher Brothers & Co., Ltd., of Switzerland, and other European manufacturers.

* * *

**Mr. Laubscher** was born and educated in Switzerland and had been an officer in the Swiss Army before coming to this country as a young man.


*Another Development ... by Hubbard!*

**PLYWOOD MARRIES STEEL**

**FOR BETTER SHOP REELS**

RESULTING IN

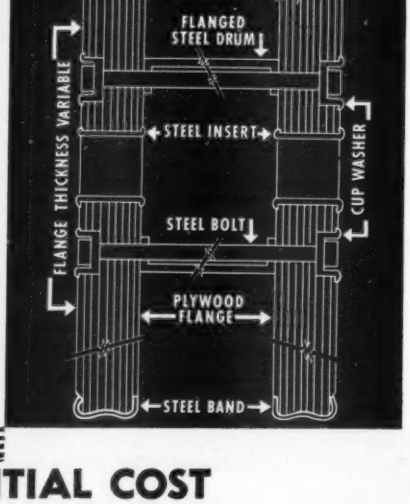
1 GREATER IMPACT STRENGTH

2 LOWER MAINTENANCE COSTS

3 LIGHTER WEIGHT FOR EASIER HANDLING

4 CAN BE SUBMERGED IN WATER

5 WIDE RANGE OF SIZES




**LOWER INITIAL COST**

FOR DETAILS CONTACT

**HUBBARD SPOOL DIVISION**

*The American Pulley Company*

GARRETT, INDIANA

# A Review of Recent Wire Patents

**The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.**

**Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.**

No. 2,907,164, MACHINE FOR LAPPING STRIPS OF MATERIAL ON ELECTRIC CONDUCTORS AND OTHER ARTICLES, patented October 6, 1959 by George Thomas Wilson Grieve, Shooters Hill, London, and Stanley Warwick Ripley, Gravesend, Kent, England, assignors to British Insulated Callender's Cables Limited, London, England, a British company.

The machine is adapted for simultaneously applying superimposed helical layers of tape as a covering about an elongate wire conductor.

* * *

No. 2,907,815, INSLUATED CONDUCTOR FOR COMMUNICATION CABLES AND THE MANUFACTURING METHOD OF THE SAME, patented October 6, 1959 by Kyohei Yokose, Mori, Motoyama-cho, Higashinada-ku, Kobe, and Masao Sugi, Toyonaka-shi, Osaka-fu, Japan, assignors to Sumitomo Electric Industries, Ltd., Konohana-ku, Osaka, Japan, a company of Japan.

Wound about the wire conductor are two insulated paper tapes having diametrically positioned ears in the shape of an S, the diametrical portions of each ear extending in the same direction around one half of each side of the wire and in spaced relation with that portion of the tape cover directly over the wire to form an air space on each side thereof. The ears are so positioned as to form a continuous opening in each air space.

* * *

No. 2,908,484, BARBED WIRE SPIRAL, patented October 13, 1959 by Siegfried Uhl, Augsburg, Germany, assignor to Keller & Knappich G.m.b.H, Augsburg, Germany, a corporation of Germany.

This barbed wire includes metal ribbon provided with spaced alternate barbed and recessed portions on opposite sides of the longitudinal axis of the ribbon, the portion of the metal ribbon on the longitudinal axis at the barbed portions and at the recessed portions extending offset along the longitudinal axis of the ribbon and providing a continuous channel offset at one side from the barbed portions for snugly receiving a reinforcing wire therein.

* * *

No. 2,908,490, FINE WIRE DRAWING FURNACE, patented October 13, 1959 by William St. John, Bloomfield, and Thomas A. Hoffmann, Newark, N. J., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania.

A heat baffle is provided within the wire drawing furnace adapted to retain heat within the furnace, contain the products of combustion within the furnace as a protective atmosphere for the wire passing therethrough and prevents fluctuations of heat within the furnace due to drafts. There is associated with the baffle, a corrugated device, disposed about the wire, to slow the flow of gas thereabout.

* * *

No. 2,908,910, WIRE CUTTING AND TERMINAL ATTACHING MACHINE, patented October 20, 1959 by Karl H. Andren, West Allis, Wis., assignor to Artos Engineering Company, Milwaukee, Wis., a corporation of Wisconsin.

Movable wire guides are adapted to close so as to cause the leading end of the wire stock to be properly located whereby a terminal may be affixed thereto.

* * *

No. 2,908,918, BED FRAME, patented October 20, 1959 by Henry Hopkes, Jr., Grosse Pointe, Mich., assignor to No-Sag Spring Company, Warren, Mich., a corporation of Michigan.

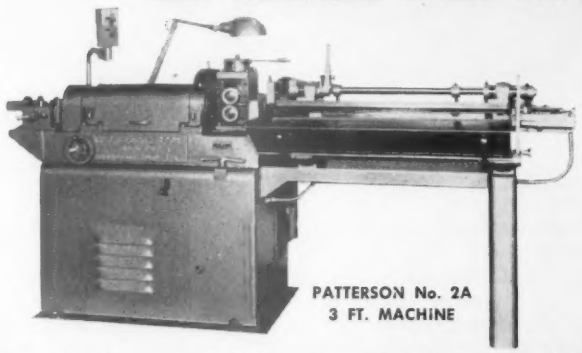
The sinuous wire springs are secured to a continuous flange portion of an extruded metal frame.

* * *

No. 2,909,209, APPARATUS FOR MAKING HELICAL ELECTRIC RESISTANCE HEATING WIRE COILS AND PROVIDED WITH A ROTARY MANDREL AND A PRESSING ROLL HAVING AN ELASTICALLY DEFORMABLE COIL EMBRACING SURFACE, patented October 20, 1959 by Patsy Ciccone, Cranford, and William Walter Wallin, Kearny, N. J. assignors


GEO. C. PATTERSON
HI-SPEED
AUTOMATIC WIRE STRAIGHTENING & CUT-OFF MACHINES

ELECTRICALLY OPERATED
with VARIABLE SPEED DRIVE



PATTERSON No. 2A
3 FT. MACHINE

We are proud to present this machine & 35 additional models to the mills and fabricators of wire, for we honestly believe they are top value in their field today. We have spared no expense to give you a precision machine tool that will give years of uninterrupted service. All iron castings are close grained Meehanite iron; cut-off and opener levers are high grade steel castings; all guides are hardened tool steel; electrical equipment is wired ready to run.

- MINIMUM COST
- MAXIMUM PRODUCTION
- ACCURATE LENGTHS
- NEW FEATURES

WRITE FOR FREE LITERATURE ON YOUR REQUIREMENTS

The GEO. C. PATTERSON Machine Company

3409 TRUMBULL ST. CLEVELAND 15, OHIO
PHONE: BRoadway 1-1808

to Driver-Harris Company, Harrison, N. J., a corporation of New Jersey.

A continuously travelling wire coil is formed by the apparatus and a device is provided to abut the rear side of the first convolution formed by the wire and prevent the coil from backing up oppositely to the growing direction of the coil.

* * *

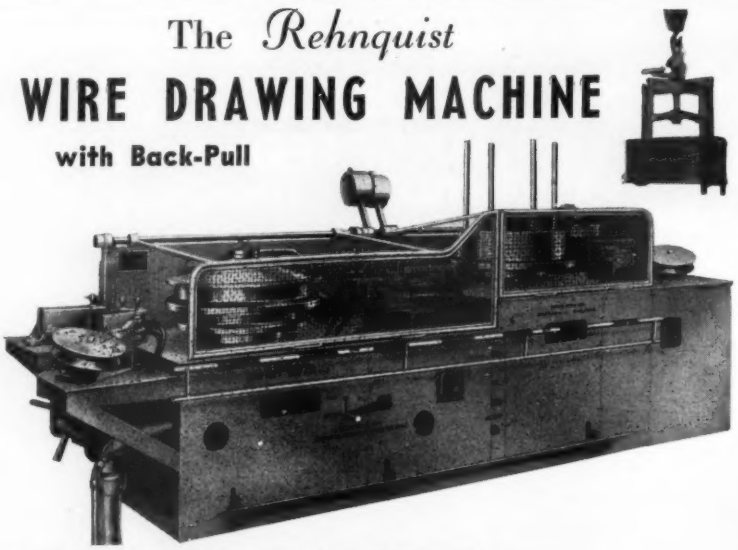
No. 2,909,275, CONTINUOUS WIRE-DRAWING MACHINE, patented October 20, 1959 by John H. Hitchcock, Worcester, Mass., assignor to Morgan Construction Company, Worcester, Mass., a corporation of Massachusetts.

This machine comprises, in addition to the conventional die, a driven block following the die, and the drive means for the hydraulic clutch connecting the driving means to the block, this clutch having the characteristic of torque transmission dependent upon the differential in fluid pressure across the clutch, a support for the die comprising one element of a control valve of a hydraulic system, mounted on the machine base so that it may move relative to the base in line with wire travel in response to changes in die reaction, another element of the control valve fixed relative to the base and cooperating with the one element, a valve regulating the pressure of fluid in the clutch, the hydraulic control system being connected to the valve so that the pressure may change in response to movement relative to the base of the support.


The *Rehnquist*

**WIRE DRAWING MACHINE**

**with Back-Pull**



**A NEW CONCEPT OF EFFICIENCY**

Counterdrawing, or back-pull, increases die life and consumes less power.

While good for any wire, these machines are especially efficient in drawing Stainless, High Carbon and Resistance Wires.

A single motor drives the machine, different blocks being connected by gears operating through differential gears. Important feature of the differential is the automatic adjustment of all blocks to each other to maintain tensions without slippage. Wire runs from block to block with no accumulation or twisting.

All dies and blocks water cooled. Pneumatic controls stop the machine if reel trouble develops. Full safety features to highest standards built in. Construction is heavy for long service. Finishing block supplied in diameters required for your operations. Machine occupies floor space of 12′ by 9′ overall. Motor is 85 hp, 2-speed AC, 865/1730 rpm. 4-speed gear box gives 8 different speeds of from 108 to 1380 fpm.

Get the facts on these remarkable machines.

Write or Telephone

**General Agent for Canada and U.S.A.:**

**ATLAS POLAR COMPANY LIMITED**

**POST OFFICE BOX 160 TORONTO 16, CANADA**

**Tel.: Plymouth 7-3641**


No. 2,909,360, BARBED WIRE, patented October 20, 1959 by Raymond S. Doerr, Battle Creek, Mich., assignor to Dare Products, Incorporated, Battle Creek, Mich., a corporation of Michigan.

A barbed wire is provided comprising a main wire strand having at least one portion having a series of offset bends lying in a single plane, a barb having a mid portion in the form of a flat spiral, the several turns of the spiral engaging the successive bends of the main strand, and the barb having terminal portions engaging the main strand adjacent the terminal portions of the main strand bends.

* * *

No. 2,909,781, MULTIPLE NAIL CLIP, patented October 27, 1959 by John L. Ollig, Marvin E. Hirsch, and Reuben V. Miller, Winsted, Minn., and James M. Westerholm, Seattle, Wash., assignors, by mesne assignments, to The First Bank of Grantsburgh.

A multiple nail clip is disclosed comprising a number of headed nails arranged in tier formation, one above the other with the heads of successive nails from the inner side of the unit outwardly successively overlapping and with the shank portions near the tip ends thereof positioned at least close to abutment, thereby producing a converging of the shank portions of all of the nails in a predetermined zone extending transversely of the shank. The nails are rigidly interconnected by a frangible, non-sticky material.

* * *

No. 2,910,524, BREATHER CABLE, patented October 27, 1959 by William V. Schaffhauser, Norwich, Conn., assignor to Plastic Wire & Cable Corporation, Jewett City, Conn., a corporation of Connecticut.

This flexible breather cable comprises a number of wire conductors and a flexible impervious nonmetallic hollow tube, the conductors and hollow nonmetalic tube being disposed within the cable and having filler material filling the spaces therebetween, with the impervious tube opening outwardly of the cable; a binder layer around the filler material, conductors and breather tube; and an insulating jacket of flexible material surrounding the binder layer.

## Anaconda Elects New President

**Clyde E. Weed,** chairman of the board of **The Anaconda Company,** revealed certain plans for strengthening company management. The first major change will be the election of **John A. Coe** as a vice president of **The Anaconda Company.** In this new position, Mr. Coe will have his office at Anaconda's headquarters, 25 Broadway, New York, N. Y., but will continue as chairman of the board of directors of The American Brass Company. **Richard M. Stewart,** president of **The American Brass Company,** will in addition become chief executive officer of that subsidiary. Mr. Stewart's headquarters are located at 414 Meadow Street, Waterbury, Conn.

## Vacuum Annealing of Wire

(*Continued from page* 1609)

ly spaced apart, is eliminated, and this effects savings in the cost of transport and service personnel.

* * *

**Fig. 5** shows a gas-fired black

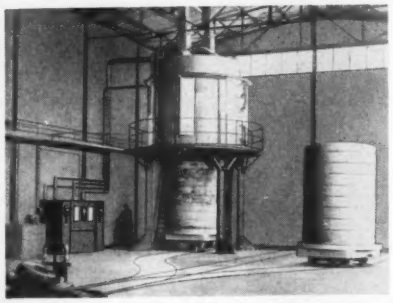


**Fig. 5 — Gas-fired black annealing furnace.**

annealing plant having a daily output of about 40 tons with charges of from 7 to 10 tons of low-carbon wire.

* * *

**More** than 200 of such modern annealing plants have been installed during the past 10 years in works all over the world, some installations consisting of several furnaces.

* * *

**Fig. 6** shows, for instance, an

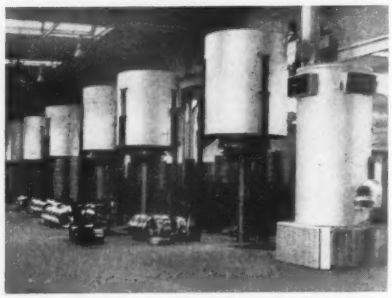


**Fig. 6 — An installation of a number of stationary annealing furnaces in a large cable works.** * * * * * * * * * *

installation comprising a large number of stationary annealing furnaces in a prominent European cable works.

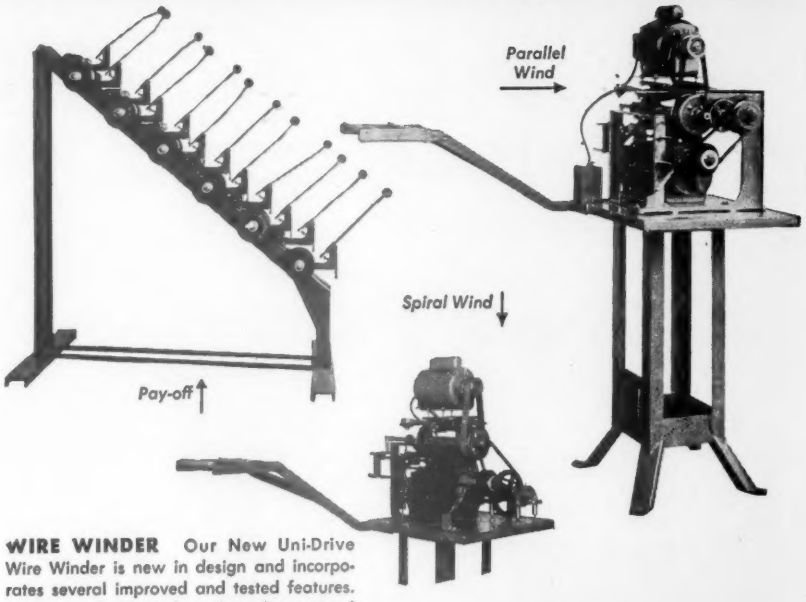
* * *

**It** should be added again that this furnace design offers great advantages in regard to servicing and can effect considerable savings in man-power and thus in wages. With only one workman per shift, two or even three annealing plants or two gas-fired annealing furnaces with a preheater arranged between them can be properly operated. Experience shows that both shaft furnaces and hood furnaces with a movable heating hood require twice, if not three times the number of personnel.

* * *

**In** conclusion, a patented cooling method should be mentioned which is employed now and then when bright-annealing copper and which helps to shorten the long cooling-down period. Copper should cool down under vacuum to at least 120°F, in order to avoid its subsequent oxidation. For cooling-down compact charges (wire on reels, profiled wire or copper strip) from 24 to 36 hours may be necessary. A so-called "Rapid Cooling Aid" was developed some years ago which makes it possible to shorten the cooling-off time by about one-third and even more. This system operates in such a way that after lowering the pot from the furnace, an inert gas available in bottles is blown into the evacuated pot for a period of 15 to 30 minutes. The gas molecules form, so to speak, an additional bridge for the heat to wander from the annealed material to the bell's wall and from there to the surrounding atmosphere. The


**STANDARD UNI-DRIVE WIRE WINDER**



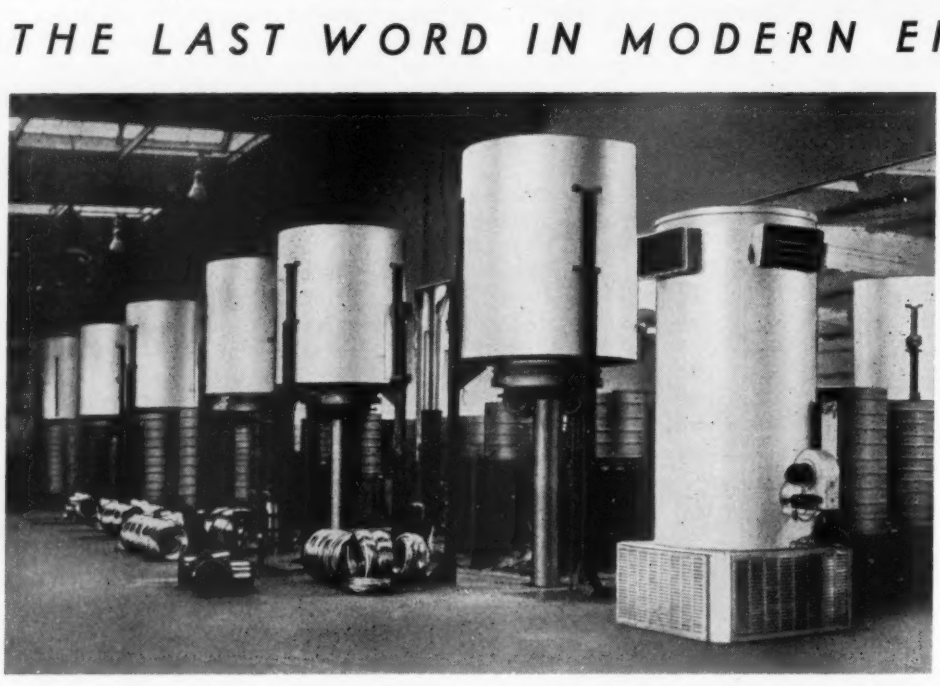

**WIRE WINDER** Our New Uni-Drive Wire Winder is new in design and incorporates several improved and tested features. Production is stepped up through increased speed. It produces smooth, even and accurately wound spools of wire in single or multiple ends. All strands parallel — no over or under-winding. Can also be furnished with a slight spiral pattern for winding exceedingly fine wire. Automatic Stop Motion controls each strand. Traverse adjustable from 1¾" to 5½" between spool heads without changing cam. Designed especially for winding wire to be braided and shielded for electrical conductors.

*Various types of supply packages that may be wound on Standard Uni-Drive Wire Winder.*

**PAY-OFF** Our Pay-off Attachment consists of a heavy fabricated frame on which Pay-off spools are mounted to cover desired number of ends to be wound. Equipped with spindles, running on self-aligning ball bearings, with size of spindles and adapters to accommodate customers' pay-off spool. Compensating Attachment to control the tension of each individual strand of wire, applying the same tension when spool is full as when empty. Can also be adapted for use with bunching machines.

**STANDARD MILL SUPPLY COMPANY**
31 ESTEN AVENUE PAWTUCKET, R. I., U. S. A.

## THE LAST WORD IN MODERN EFFICIENT DESIGN!



**SEVERAL VACUUM BRIGHT ANNEALING UNITS WHICH WE HAVE INSTALLED IN ONE OF THE MOST PROMINENT CABLE WORKS IN GERMANY**

(German and Foreign Patents)

*

**SOLE REPRESENTATIVE:**
**PAUL REICHER**
**Machinery & Equipment**
**600 Eglington Ave., East,**
**Toronto 12, Ont., Canada**

**OFENBAU FRITZ G. m. b. H. & Co. K. G. HAGEN, (W.-GERMANY)**

(Mfg. under Patent 2,391,983)

**used by wire men who want the best!**

## Sjogren AUTOMATIC DIE SIZERS

Another SJOGREN-BUILT Machine for "wire men who want the best!"

This Automatic Die Sizing Machine is available in 2 models — the Six Spindle (as shown) and the Single Spindle unit. Both models are identical in construction and the same production per spindle applies. Typical production per spindle, per hour, on the six spindle machine is:

| | |
|---|---|
| **2 dies at .165"** | **8 dies at .082"** |
| **4 dies at .135"** | **10 dies at .072"** |
| **6 dies at .095"** | **15 dies at .062"** |

*(Total of 45 dies or more, per hour)*

Sjogren engineers cordially invite wire men who are interested, to make a visit. If desired, a test run will be arranged, using their own dies, pins and compound.

**Sjogren TOOL & MACHINE CO., INC.**

**14 Sword St.**
**AUBURN, MASS.**

WIRE PULLERS • WEDGE GRIPS • JAWS FOR ALL MAKES OF PULLERS AND TESTING MACHINES • GAGE ROLLERS • SWAGING HAMMERS • POINTING DIES • WIRE SPOOLERS

"Rapid Cooling Aid" is advantageous not only because the annealed material will be available much quicker for further processing, but also because savings in money and space can be made by acquiring fewer pots. As an example it may be stated that a Vacuum Bright Annealing Plant in continuous operation requires from 5 to 6 pots when equipped with the "Rapid-Cooling Aid"; whereas from 8 to 10 pots are necessary if the plant is run under normal conditions, i.e., with normal cooling-off time.

* * *

**Temperature** in the annealing pots is uniform in all spots. The furnace has various heating groups or ranges which can all be individually regulated.

* * *

**Needless** to say, the entire plant is provided with modern electrical equipment, temperature control, temperature recorders, indicators, safety gear, etc.

* * *

**Finally,** it should be stated that vacuum furnaces are particularly desirable when a bright and brilliant wire surface is required, which can never be obtained with the same fine result, with the same economy of operation, and practical working manner by any other annealing method or system actually on the market.

### Wire Kinks

(*Continued from page* 1631)

**In** January 1959, Bradford Beggerly, of the works engineers made a study of this problem, and subsequently he designed and had made a jig consisting of two main portions and a number of small pins. The two major pieces were inserted into jaws of a Riehle Tensile Testing Machine which is located in the wire mill laboratory. The upper piece, known as a roller head, has a dial selector with drilled holes for inserting the proper size twin rollers. The lower piece, known as the pin holder, has a single drilled hole for the insertion of a pin equal in diameter to two times that of the wire to be tested.

**In** practice, the pieces are placed in the tensile testing machine, with the face sides (pin side) face to face and barely permitting clearance. The upper head is run down to allow passage of the wire to be tested between the twin roller pins and the center bending pin. The machine is reversed, as in tensile test operation, and the upward stroke bends the wire neatly, effortlessly, and with minimum danger to the operator.

* * *

**In** May of 1959, the new jig was put into use and it has proved to be far superior to the old method. It requires no physical effort other than inserting the specimen into the jig. The operation is safe and enables the inspectors to make more tests per day.

### New Hydraulic Bending Machine

**The J. A. Richards Company,** 903 N. Pitcher St., Kalamazoo, Mich., has announced production of two new models in its "Multiform" line of hydraulic bending machines. The newest of the "Multiform" series are the Model BB-H (illustrated here) and the Model BB-C, a heavy-duty machine of larger

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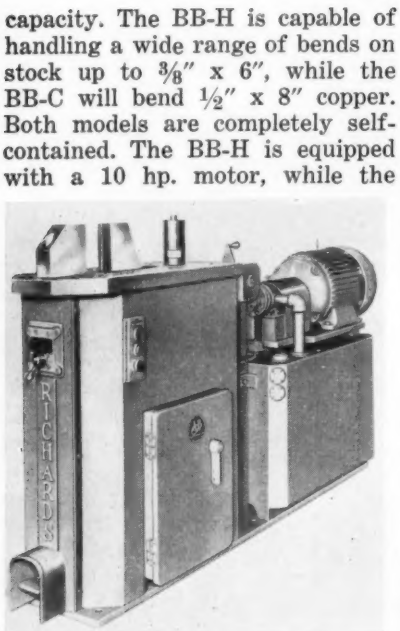
capacity. The BB-H is capable of handling a wide range of bends on stock up to ⅜" x 6", while the BB-C will bend ½" x 8" copper. Both models are completely self-contained. The BB-H is equipped with a 10 hp. motor, while the




Richards Model BB-H Bender

BB-C carries 15 hp. Both models feature a constant-power hydraulic system, which, through a toggle action, provides a constant source of power regardless of the thickness of the material being formed. Model BB-H is capable of speeds from inching through 21 strokes per minute, while the BB-C operates on a complete cycle of 4 seconds.

* * *

A folder describing the Richards line, Circular R-9, is available upon request to the company.

### Announces New 36" Single Reel Take-Up

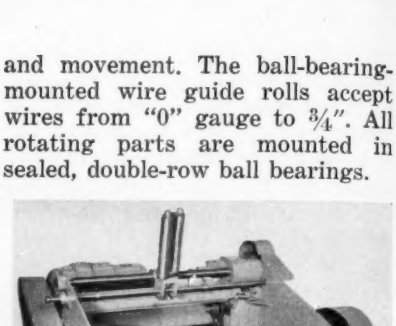
A new 36" Single Reel Take-Up for wire insulating lines is announced by **Davis-Standard, Div. of Franklin Research Corp.**, Mystic, Conn.

* * *

The new unit, Model SR 36, is designed for wire speeds up to and exceeding 2000 FPM. It handles reels from 12" to 36" in diameter, up to 24" wide. Full reels up to 2000 pounds can be accommodated.

* * *

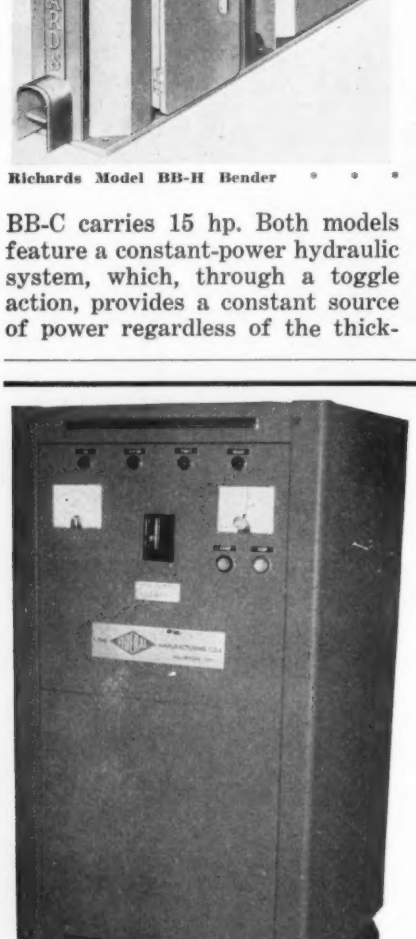
The 36" Take-Up has pneumatic reel arms, adjustable Dog Pin and infinitely adjustable traverse lay and movement. The ball-bearing-mounted wire guide rolls accept wires from "0" gauge to ¾". All rotating parts are mounted in sealed, double-row ball bearings.



Available with a variety of drives, Model SR 36 is a fast, compact take-up for general wire insulating operations. Complete specifications are available on Davis-Standard Catalog Section 8.7.

### Analysis of 1959 Revision of National Electrical Code, 200-1959

A great many changes, both in substance and in editorial arrange-

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ment, have been included in the 1959 edition of the National Electrical Code.

* * *

To assist users in comparing the 1956 and 1959 editions of the Code, Howard Michener of the NEMA Staff has prepared an Analysis of the changes which have been approved since 1956. All those who must be familiar with the Code will find this Analysis of inestimable value.

* * *

Copies of the Analysis are available at 50 cents each from the National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y.

### G E Department to Expand

General Electric's Insulating Materials Department has announced plans for a five-year, multi-million dollar expansion program in Schenectady to accelerate development of new products and improve customer service.

* * *

Department General Manager T. C. Ohart said the expansion would put the department in a position to develop new processes and products for the entire electrical industry. The department will continue to operate its manufacturing facilities in Pittsfield and Chelsea, Mass., and in Coshocton, Ohio, even after completion of the Schenectady consolidation program.

### New ASTM Standards on Electrical Insulation (D-9)

Magnet Wire. The Society's first standard relating to magnet wire, the Tentative Method of Test for Frictional Characteristics of Enameled Magnet Wire for Use in Winding Filled Coils (D-1676) has been approved. The test results indicate the amount of spooling oil present on the wire. This property is important because wire with insufficient lubricity tends to produce oversize, uneven windings, and excessively oiled wire tends to fall into the space at the coil ends rather than to maintain a compact helix. The method is suitable for control, acceptance, and service evaluation.

* * *

Cellular Plastics. Another first by Committee D-9 is the new method for measuring dielectric constant and dissipation factor of cellular plastics. Cellular plastics always have lower dielectric constants than the solid material from which they are derived. The dielectric properties are important because they determine the capacitance between conductors when the plastics are used for encapsulating electrical circuits or components. In transmission lines such as television lead-in cables, etc., expanded plastics are often used to lower the capacitance per foot of cable and to improve propagation characteristics. Cellular plastics are also used in waveguides, radomes, and dielectric lenses for microwave radio and television transmission. In these applications the dielectric properties of the materials are of great importance.

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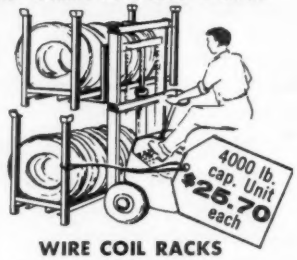


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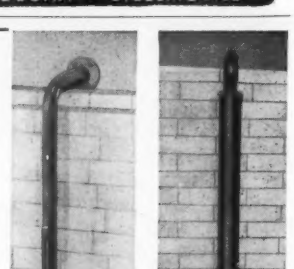

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## Tension in Wire Engineering

(*continued from page* 1622)

and long pay-off lines of the wires to absorb elastically the tension-changes. For heavier wires, controls are in use which are often based upon the deflection of a contacting element in response to the changing package diameters. One of these control systems using an idler is described by Hanna and his co-workers*). There are also other control devices in existence.

* * *

**The** maintenance of constant tensions is involved. Not only do effective diameters change in non-round coils but in addition we are dealing with a system whereby the radius of the originating package is reduced (when it is a spool) while the coil builds up simultaneously.

* * *

**Whereas** we have mentioned above for purpose of clarification some simpler physical relations, it should not be overlooked that the compound system requires deeper engineering understanding. The speed of the wire, the coil to be wound and the originating package all introduce variables singly and in combination.

### Tensions In Multi-Conductor Wires and Sleevings

**The** importance of tension checks in covering wires with plastic is not only that the same tensions are applied at different settings and at different times. It is also important when two separate wires are laid into a cable simultaneously that both should have the same tension. Otherwise, upon the de-reeling of the wire, after the insulation has set, the one conductor that has been stretched more during the history of its production will contract more when released. Accordingly, since this is the more contracting conductor, the cable then has a tendency to curve in the direction of the wire which was exposed to the higher tensions before being covered with the insulating sheath. This is an important factor for keeping cables straight when unrolled as required by the specifications of the U. S. Signal Corps and other military agencies.

*) C. R. Hanna et al. U. S. Patent No. 2,285, 654, June 9, 1942.

### Tensioning By Mechanical Friction

**What** can be done to control tension on the quickly moving, fine enameled wires of copper, platinum, or of nichrome-resistance wires without damaging them permanently?

* * *

**Many** present devices make use of frictional restraining means. Hereby, the wire is led through rubbing surfaces in contact with the moving wires. These "brakes" may range anywhere from felt pads and oiled cork to metal disks and similar rubbing, retarding and pinching surfaces in contact with the wire. Another instance of frictional tensioning takes place when a braking drum connected to the wire or spool is retarded by frictional contact with a rubbing surface.

* * *

**The** critical limitation of all these wire contacting devices is that **they exert friction on the surface** of the sensitive wire when in direct contact with it. **They rub it and thus subject it to abrasion.** Another common defect of all devices of this type is that the braking action of the pressure fingers is concentrated within too small an area. Excessive stress concentration takes place then within too short a length of wire to which it is applied thus damaging it. Even if the indirect retardation of a brake drum is used, its **stick-and-slip action produces hunting** and thus variations in tension. In addition in such instances where mechanical non-slip action is produced by crimping the wire over serrated wheels or boards, the wire is frequently deformed, kinked and permanent strains are set up in it.

* * *

**In** enameled wire, frictional tensioning devices reduce the size of the insulation first (by abrasion). In addition they produce a "stick and slip" tension. That is to say, the tension in a frictional tension device is higher at the start until the "break away" tension has ceased. Thereafter, the (lower) running tension takes over.

* * *

**Thus,** not a constant tension is


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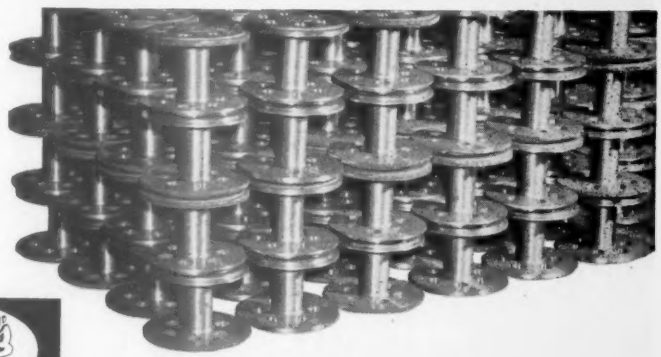

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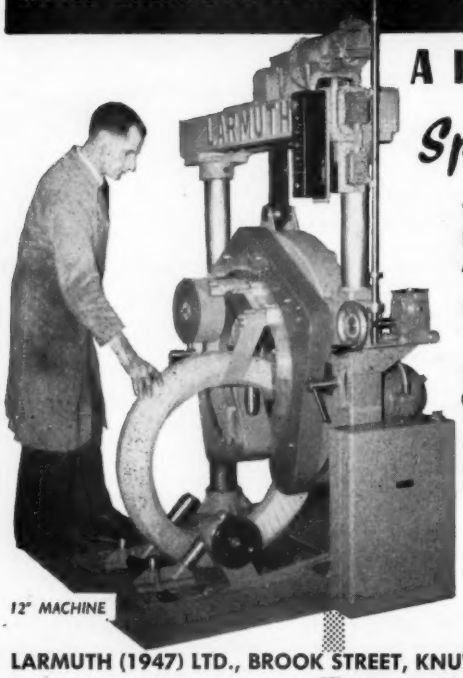

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produced. A variety of tensions are caused instead particularly during a quick start and stop. This effect is further emphasized by the adhesion of one wire to the other in an unevenly wound supply package which lets go of the wire with different tensions even before the tensioning device has been reached.

* * *

**Such** variations of the infeed tension are at times mechanically amplified particularly when oscillatory resonance is initiated mechanically as sensed by the dancer arm and fed back to the braking surfaces with the overshoot produced by the motion of comparatively large inertial masses.

* * *

**In addition,** a separate form of mechanical feedback occurs (this time of higher frequency) when crimping tension boards or serrated wheels set up vibratory tensions in the wire that is deformed and put into oscillations while passing through such frictional restraints.

* * *

**Between the** "stick and slip tensions" and the abrasive action on the enamel, or the bending deformation of the wire (crimp) — as it is done in washboard type tensioning devices whether flat or of wheel shape — tension becomes a problem for the more sensitive materials and their insulation.

### Controlling Tension Electrically

**Rotating** heavy coils, sticking of wires against each other and against bobbin surfaces together with the frictional restraints operated by large dancer arms are but a few of the several causes for hunting and variables of tension that interfere with the wire delivery at uniformly smooth and constant tension.

* * *

**Accordingly,** it was necessary to devise a fundamentally new concept. It makes use of a deformable, expendable cover attached to a stiff, light-weight wheel of minimum inertia. By guiding the wire over the wheel the linear motion of the wire is converted into a rotary motion. This latter can be brought under control by mag-

netic, electro-magnetic and other methods of smooth and stepless retardation.

### Electric Tension Control Figure No. 10

**Figure** No. 10 shows this electrical tension control. Special coverings have been developed which are gentle to the finest wires, even smaller than .0005". Moreover, the special, expendable non-slip covers

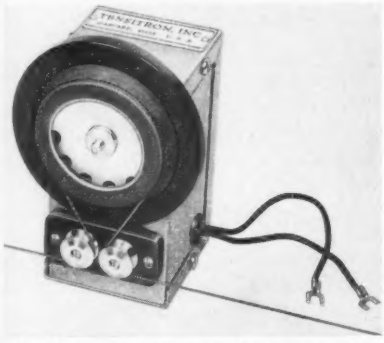

Fig. 10 — Electric Tension Control. Courtesy Tensitron, Harvard, Mass.

are not attacked by the chemical action of copper. In some instances, the pulley covers consist of a two layer plastic. The lower layer is yellow and the upper one is black. The upper layer has serrations in its groove to increase traction between wire and wheel cover. Accordingly, as the upper layer wears — as it will eventually — the lower layer of yellow shows through and indicates thus in a simple manner when the expendable cover should be "retired".

* * *

**There** are also non-slip covers in use that are made of special textile materials.

* * *

**This** new electric tension control gives non-slip traction of wires regardless how thin their insulation. Regulation can be made if desirable by distant control which also permits synchronization with the motor drive.

* * *

**Infinitely** adjustable tension, no abrasion between the rotating wheel and the wire in contact with it (and therefore, no stick-and-slip tensions as well as freedom from flake-off of the insulation covering the wire) and stress distribution over a significant length of wire


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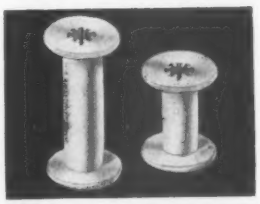

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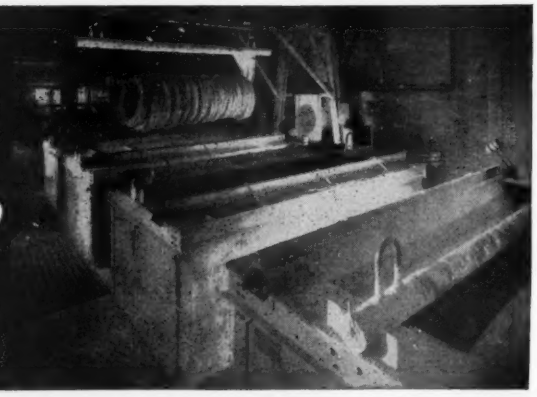

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are thus made possible. Tension adjustments are simple and tension can be either pre-programmed or sensed and controlled as the coil builds up and tensions have to be changed.

### Parameters Influencing Tension

**Shock-tensions** that occur during the starting up and stopping of the operation are aggravated when the traverse on a wire coil reverses from right to left and vice-versa.

* * *

**Over-imposed** over these short time tension fluctuations and other short-period events that influence tension there are the sudden tension increases as the wires stick at times against each other and on certain points of the dereeling package. In this category belong also such tension variations that are produced by an overhead-pull-off device when the wire gets caught on a flange or leaves the spool with uneven tension.

* * *

**Among** other factors that influence tension and wire transport, consideration should be given to the contact angle. It makes a difference to the generated tension whether the wire touches the capstan or the bobbin perpendicularly to its axis of rotation or at an angle with it. Also tension is influenced by the slippage of a wire on the capstan (and thus the surface condition of the latter). Last but not least, some capstans are of slightly conical crossection . . . another factor in imparting tension to the wire in a predetermined manner.

* * *

**There** is, furthermore, the gradual, long-time change as a multiple coil builds up from the layers close to its mandrel or inside of the bobbin until it reaches the final shape of its larger outside diameter.

* * *

**The** change in coil diameter and thus the speed of wire transport for constant R.P.M. winding has its effect upon tension changes. As a function of varying coil diameters, they are influenced by whether the filamentous material is applied near the inside bottom

layers or close to the outer form near its finished coil-diameter. Moreover, while the coil to be produced is wound, the supply package becomes smaller. This causes changes simultaneously in the de-reeling tension while the wind-up coil builds up . . . a complex state of conditions.

* * *

**The** tension variations as the storage package gradually unwinds are critical whether this is done by overhead pull*) or by rotation of the bobbin. Moreover, windage (i.e. air-resistance) and other frictional factors enter in wire and other tension responsive processing operations (in the same manner in which they are known during the manufacture of textile yarns such as warping and throwing).

* * *

All of this taken together presents an intricate set of varying tension conditions. These factors, singly and in combination must be totalized. They represent an involved picture for the tension existing at a differential element of time and upon a given part of the bobbin or coil-form during the winding operation. They change with package size, wire-speed, coil construction, the diameter and stiffness of the wire and for other reasons.

## Summary

**Tension,** an engineering factor still much neglected, should be given the consideration it deserves.

* * *

**The** precise knowledge and the control of tension as based upon an understanding of the several factors involved starts with the measurement of tension as produced under the dynamic conditions of actual manufacture.

* * *

**Considering** the entire system, we are confronted on one hand with the diminishing effective diameter represented by the let-off package (when a bobbin is used on the de-reeling end) and on the other hand with the increasing size of the wound coil which gradually builds up as the material is transferred to it from the de-reel-

*) Overhead pull-off causes one turn in the wire for each turn of unwinding.

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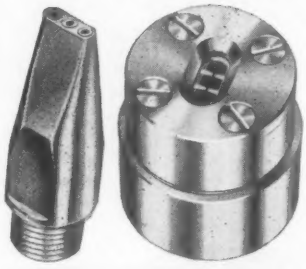

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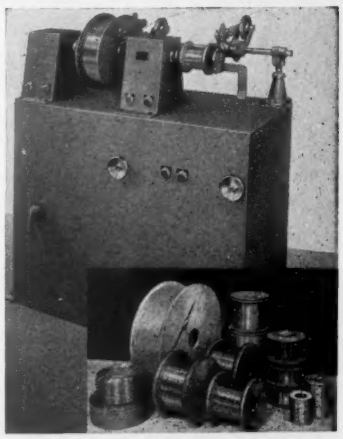

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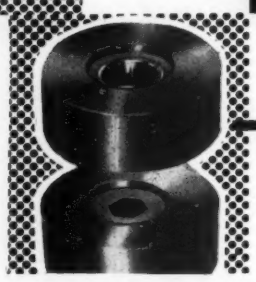

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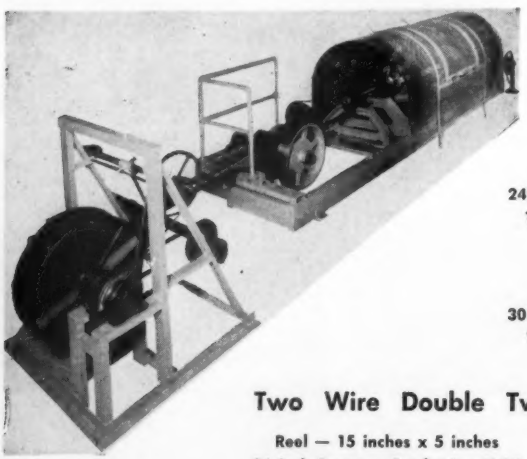

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— Reel 24 inches x 16 inches
24 inch Frame — Production — 1140
Twists per minute — Power 3 H.P.

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Reel — 30 inches x 16 inches
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ing side. This changes the relation between one creel which unwinds, delivering its wire upon a mandrel that builds up by the same amount . . . an intricate system of varying conditions that require automatic adjustment if the critical wire tensions are to remain within reasonable limits of tolerance.

* * *

A deeper understanding of the factors that influence tension is desirable. Today **tension is still too much the neglected dimension.** Tension measurements made while the wire moves and subsequent tension control help the engineer to improve and maintain better wire-drawing, coil-winding and wire-processing operations. It is of particular value in the manufacture of such essential elements of construction as, for instance, precise electrical coils and fine-wire potentiometers which have to retain their reliability under the severe environmental conditions for the finished coil and at the higher production speeds that are required in this age of electronics, automatic control and supersonic missiles.

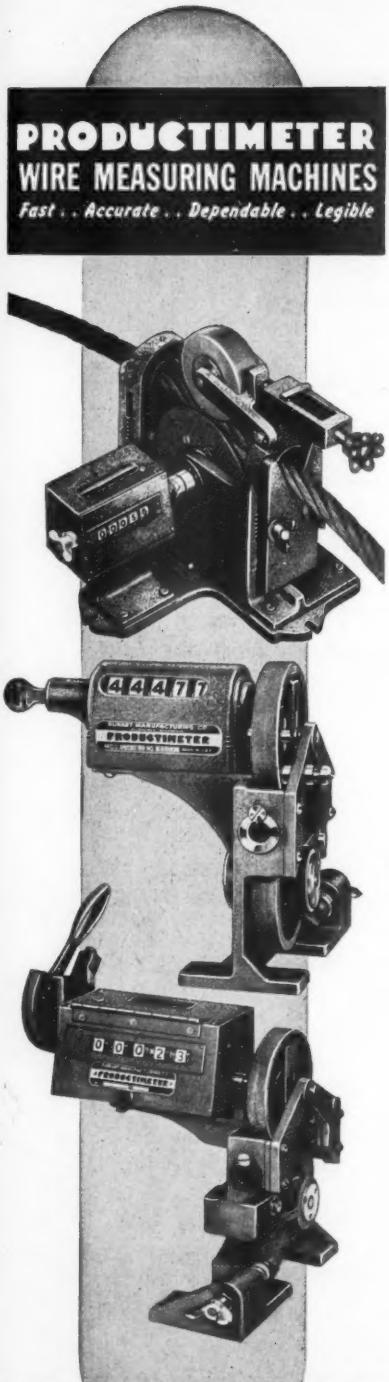
* * *

**In** wire and other filamentous materials we are dealing with a characteristic tensile relation essentially determined by the material constants of the wound product and the size and speed of the packages that hold it. The quantitative measurement and control of tension permits the monitoring of such stress and strain that may be considered safe and economical in wire winding and similar operations.

* * *

**To** manipulate by methods or trial and error processes as mutually interdependent as tensions . . . and to compensate for their quick changes at the steadily increasing production speeds, poses problems of multiple control that begin to exceed personal monitoring. Automatic controls designed to fit the system of mutually changing parameters, and particularly a true science of Tension Engineering based upon a thorough understanding of the many phenomena involved, becomes then mandatory.

* * *

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**While** by no means a cure-all, the measurement and subsequent control of tension brings about a systematic improvement in one of the major variables of wire manufacture and processing that were given but scant attention to date. This does not mean that other important parameter that are essential for wire-production and — handling must be allowed to fall into disregard. It does mean, however, that one of the factors that significantly influence the material constants of wire, such as strength, resistance to abrasion, electrical conductivity, and magnetic parameters will be brought gradually under systematic control. It also means that excessive stress concentration over too limited a wire area should be avoided.

* * *

**Quantitative** sensing of tensions, a knowledge as to what happens to wires under tension, and, last but not least, mechanisms to compensate for tension variations are steps in the right direction. A more critical view is therefore becoming of increasing importance in the time honored craft of wire-drawing and subjecting the drawn wire-product subsequently to annealing, coil-winding and other preparatory processes.

BIBLIOGRAPHY


1) W. Thomson. (Lord Kelvin) The Electro-Dynamic Qualities of Metals. The Bakerian Lecture. February 28, 1856. pp 649-751.

2) P. W. Bridgman, The Effect of Tension on the Thermal and Electrical Conductivity of Metals. Proc. Amer. Acad., pp 120-137, October 10, 1923.

3) E. Chapman. Photo-Elasticity, A Powerful Educational Tool, Journal of Engineering Education, 41, 10, 1951.

4) K. Fink and C. Rohrbach, Handbuch der Spannungs — und Dehnungs Messung, VDI Verlag, Section 2, 1958.

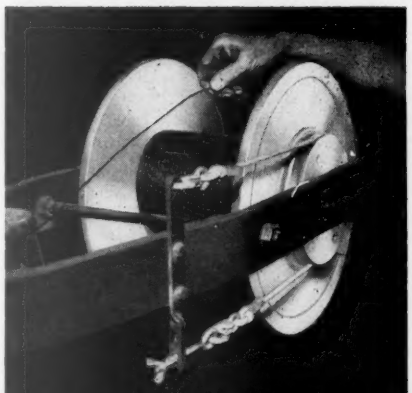
5) R. B. Heywood, Designing by Photo-Elasticity, Chapman & Hall, London 1952.

6) U.S. Patents Nos. 2,294,897; 2,310,-845; 2,325,116; 2,428,559; 2,724,-964.

7) W. G. Patton, Stress Analysis Takes Guesswork out of Product Performance, Iron Age, September 1955.

8) F. B. Stern, A New Method for Measuring High-Temperature Stress-





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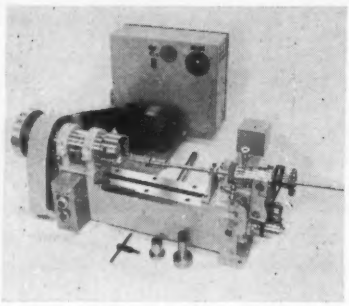

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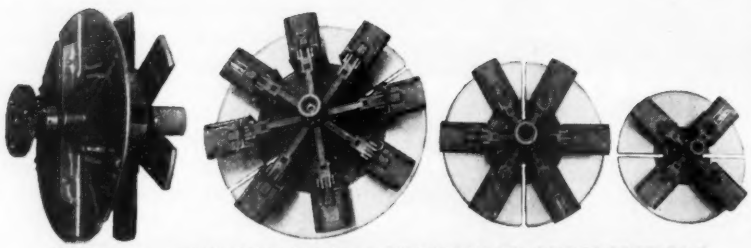

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es with Ceramic-Base Coatings. Machine Design, May 29, 1958.

9) Felix Zandman. Principles and Applications of Photostress. Society of Non-destructive Testing Handbook, 1959.

10) W. M. Murray, Seeing Stresses with Photo-Elasticity. Metal progress, February 1941.

11) T. H. Blewitt, R. R. Coltman and J. K. Redman. Low Temperature deformation of Copper Single Crystals. Journal for Applied Physics, Vol 28, No. 6, pp 653, June 1957.

12) E. Orowan. Zeitschrift fuer Physik, Vol. 89, III, pp 364, 1934.

13) G. I. Taylor. Proc. Royal Soc., London A, Vol 145, pp 362, 1934.

14) Joseph Kaiser. Untersuchungen ueber das Auftreten von Geraeuschen beim Zugversuch. Archiv fuer Huettenwesen, Vol. L, pp 43-45, 1953.

15) J. B. Lean, J. Plateau, C. Bachet and Charles Crussard. Sur la formation d'ondes sonores, au cours d' essais de traction, dans des eprouvettes metalliques. Extrait des Comptes Rendus des Seances de l'Academie des Sciences. May 19, 1958. pp 2845-2848.

16) W. P. Mason, H. J. McSkimin and W. Shockley. Ultrasonic Observation of Twinning in Tin. Physical Review, Vol. 73, No. 10, May 1948, pp 1213-1214.

17) Andrew W. McReynolds, Plastic Deformation Waves in Aluminum. Trans. A.I.M.E., 185, 1949.

18) S. Timoshenko. Strength of Materials. Two Volumes. Van Nostrand Co., Princeton 1958.

19) Measure Fine Wire Fast with Light. Electronic Design, May 27, 1959.


## Bonding Characteristics of Insulating Varnish and Wire Enamel Systems

(*Continued from page* 1624)

strength vs. test temperature. Curves for three varnishes over polyvinyl acetal enamel are shown. The top curve is a high bonding phenolic varnish formulated to give the maximum bond to armature windings of high speed motors. The middle curve is a typical general purpose oil modified phenolic varnish. The lower curve is a very flexible coil varnish. Generally one must sacrifice flexibility to obtain high bonding strength.

* * *

**Figure** 8 shows the effect of varying only the magnet wire. Experiments have shown that

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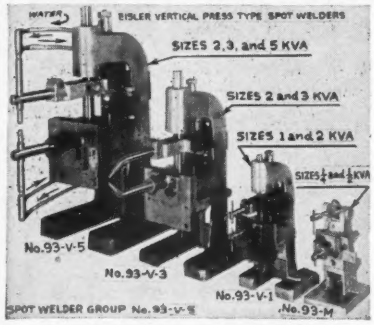

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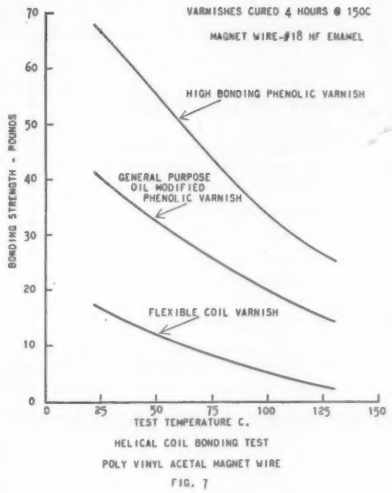
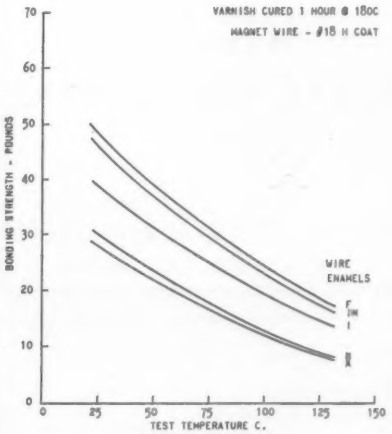

VARNISHES CURED 4 HOURS @ 150C
MAGNET WIRE-#18 HF ENAMEL
HIGH BONDING PHENOLIC VARNISH
GENERAL PURPOSE OIL MODIFIED PHENOLIC VARNISH
FLEXIBLE COIL VARNISH
BONDING STRENGTH - POUNDS
TEST TEMPERATURE C.

HELICAL COIL BONDING TEST
POLY VINYL ACETAL MAGNET WIRE
FIG. 7




HELICAL COIL BONDING TEST
COMPARISON OF WIRE ENAMELS WITH #31 POLYESTER VARNISH
FIG. 8

Enamel "F", which is polyvinyl acetal, gives the highest values for most varnishes. The varnish used here is a polyester which shows approximately equal bonding strength when applied over a polyester enamel, "IM". The bonding strength is found to be less for enamels "I", "N", and "A".

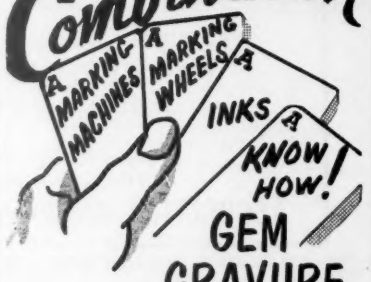
* * *

**Figure 9** shows an interesting family of curves obtained by varying the time of cure, keeping the wire enamel and varnish the same.

* * *

**Figure 10.** We have found that most varnishes will continue to increase in bonding strength to a point, and then will decrease in strength, showing the effects of heat aging.

An UNBEATABLE Combination

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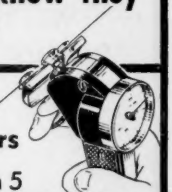

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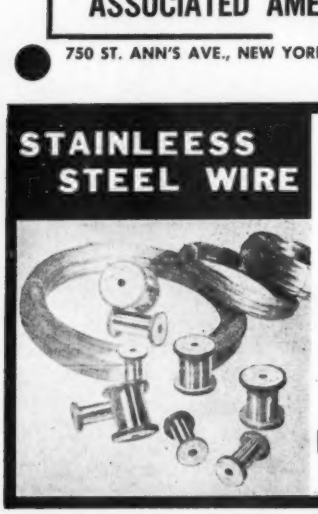
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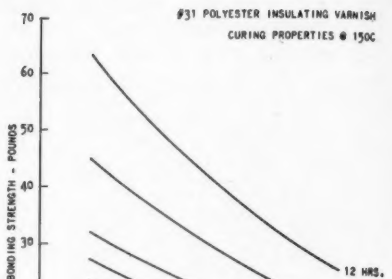
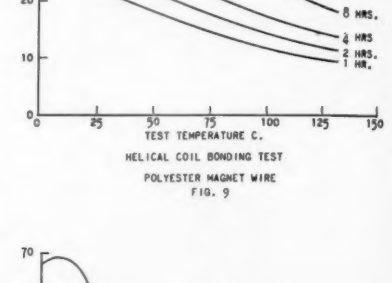


HELICAL COIL BONDING TEST
POLYESTER MAGNET WIRE
FIG. 9


#31 POLYESTER VARNISH OVER POLYESTER MAGNET WIRE
PURE PHENOLIC VARNISH OVER POLY VINYL ACEEAL MAGNET WIRE
BONDING STRENGTH - POUNDS
HEAT AGING - HOURS @ 200C
HELICAL COIL BONDING TEST
EFFECT OF HEAT AGING UPON BONDING STRENGTH
FIG. 10

**Pure** phenolic varnishes shown on Fig. 10, which reach their ultimate cure early, increase only slightly in bonding strength with additional cure. These also degrade more rapidly than do the high temperature polyester varnishes shown on the same graph. Polyester varnishes increase bonding strength more slowly with additional cure to a point somewhat lower than the pure phenolics, and then will tend to drop in bonding strength with prolonged heat. After considerable heat aging, it is noted that the failure of the bond occurs between the wire enamel and the copper, indicating an oxidation condition of the wire. Initial failures in bonding strength generally show a failure between the enamel and the varnish, or a cohesion failure of the varnish itself.

The Helical Coil Bonding Test has the following advantages:

1. **Basically, it will test how a particular varnish will hold a coil of a particular magnet wire together.**
2. **At times, we wish to know if a varnish is better with one type of enameled wire or another. To do this, we keep all conditions constant and vary only the enameled wire.**
3. **When is the varnish properly cured? By varying the baking cycle and testing a series of coils, the optimum cure time and temperature can be found.**
4. **The user may have a particular curing schedule (such as in a conveyor system) which cannot be altered easily. To find a varnish that will fit into this cycle, varnished helical coils can be run through the system, varying the varnish until the proper results are obtained.**
5. **Quality control of incoming materials is important to many manufacturers. The helical coil test has been included in some acceptance specifications to eliminate offgrade shipments of wire or varnish.**
6. **As a research tool, this test may help us choose the best formulation for a new varnish and will tend to screen out the "dogs" and speed up laboratory work.**
7. **Initial bonding strength is important. The coils of a motor must hold together when it is started up for the first time, often under full load. The motor must hold together also for years under all operating conditions. A test of bonding strength after conditioning the coils in a laboratory will test the suitability of a varnish under long-term operation.**

   **Conditioning by aging at high temperature, by immersing in hot oil, a humidity cabinet, a salt spray tank, or in special atmosphers (such as a Freon bomb) will test the properties of a varnish under these simulated operating conditions.**

* * *

**Various** working groups among AIEE and ASTM committees are utilizing the Helical Coil Bonding Test to investigate properties of varnishes such as cure, bonding and some of the other special properties described above. The real advantage of this test is its simplicity, low cost, and the reproducibility of the results. Engineers agree that the results obtained are significantly comparable to those obtained in actual operating equipment. We look forward to the time when this test will become a standard test procedure for determining bonding strength of insulating varnishes and wire enamel systems under these varied conditions, and we will continue to use it in our labotory as an important quality con-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trol and evaluation method for our products.

## The Manufacture of Wire Products —Oven Racks, Baskets and Refrigerator Shelves

(*Continued from page* 1627)

**(Figure No. 18)** — This photograph shows the final parts being taken off the lacquer line and being packed ready for shipment.

Fig. 18 * * * * * * * * * *

The desire and demands for better finishes as well as decorative appearances have led us to continue a research and development program for better finishes in order to compete against the greatest competitor we have, and that is aluminum.

* * *

**In** this development program we have found what we believe to be the most promising finish which answers a majority of our problems. This process is known as the "CORVEL" Fusion Bond Process. It was developed in Germany and was brought to this company by The National Polymer Corporation who is the licensee for the entire Western Hemisphere. We were fortunate to become one of their licensees at the beginning of the introduction of this process in this country. The process essentially consists of the pre-heating of the part to be coated and then dipping the part into a fluidized bed of the powder material and a post heat to complete the fusion of the material. This method of coating can utilize several materials such as Vinyl, Cellulosic, Nylon, Polythene, and Epoxies.

* * *

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Vinyl material and is found to be most satisfactory in resisting humidity, detergents and abrasion.

* * *

**(Figures 19 and 20)** — We have attempted to show you our processes from the raw wire to the

Fig. 19 * * * * * * * * *

Fig. 20 * * * * * * * * *

shipping of finished parts. We use our trucks for fast delivery to our customers.

* * *

**In** conclusion, I feel that The Wire Association should enlist the aid of all members to intensify their efforts for particular finishes on steel products with naturally, particular emphasis to wire products.

* * *

**It** is my opinion that too little has been done by the steel industry to provide aid to wire fabricators for better finishes in order to combat competitive threats of non ferrous materials.

* * *

**We** have on the table some brochures covering both our "CORVEL" Fusion Bond Process and our Wire Fabrication. If any of you gentlemen are interested I would be glad if you would take these brochures with you.

* * *


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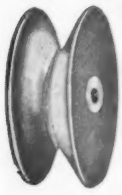

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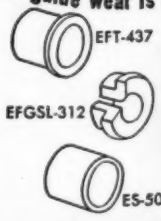


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* * *

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**Information** on allied problems is offered in two other Alpha bulletins: "Tips on Soldering," which deals with the subject of solving soldering problems, and "Flux-Finder Guide," designed to aid the user to find the right flux for every need.

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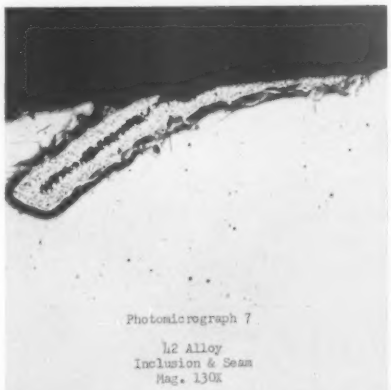
## Glass Sealing Wires

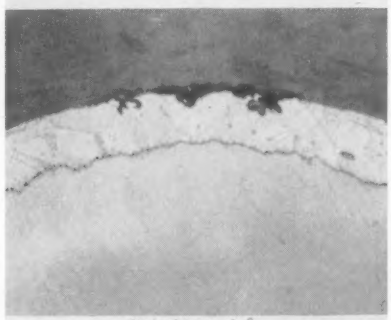
(*Continued from page* 1640)

through 10. Aside from the exposed core, slivers, and other major surface defects, which may be visually or electronically detected, these imperfections are not readily found until mounted in lamps or tubes. They may be detected in the laboratory through examining cross sections of the finished product with a microscope.



Photomicrograph 7

42 Alloy
Inclusion & Seam
Mag. 130X



Photomicrograph 8

Dumet
Oxidized foreign object in Copper surface
Mag. 650X

* * *

In summary, the lamp and electronic tube industries have attained a high degree of development in the art of sealing wires through glass. Tube manufacturers are now being asked to guarantee a .5% defective covering all major defects including glass breakage and electrical failure. The lamp manufacturers must meet an even tighter requirement of .10 to .15% overall defective. It is interesting to note that in the case of dumet, one pound of material will provide enough lead wires to produce 25,000 electronic tubes. This leaves very little room for malfunctioning lead wires.

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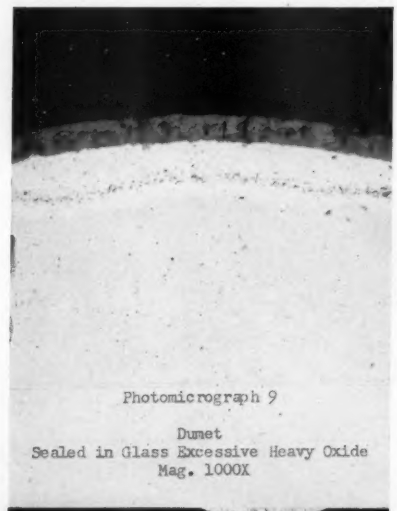

Photomicrograph 9

Dumet
Sealed in Glass Excessive Heavy Oxide
Mag. 1000X

Photomicrograph 10

Dumet
Showing uneven Core and Seams in Copper
Mag. 200X

**REFERENCES**

1. Hull and Burger: 1934, Glass-to-Metal Seals, Physics, Vol. 5, No. 12. Also, General Electric: 1941, No. 1109.
2. Kohl: Materials Technology for Electron Tubes.
3. Morey: The properties of Glass, 2nd edition.
4. Partridge: Glass-to-Metal Seals.
5. The Glass Industry: A. J. Monack.
6. Glass-to-Metal Seal Design: W. J. Scott.

## Setting Sales Objectives for Small Business

A booklet, "Setting Sales Objectives for Small Business" has been published by the Bureau of Business Management, **University of Illinois,** Commerce Annex, Urbana, Ill., in which principles to be followed by small businesses to survive and prosper under competitive conditions are discussed.

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* * *

**The** Stapak drums are of sturdy and rugged construction. Exceptionally easy to handle, they permit one coil to be removed for use while the others remain safe from dirt and contamination within the sealed drum. Featuring a new Turn-Lock positive closure and pilfer-proof seal, the drum also stacks due to a cover and bottom that are designed to interlock. Continental Can also makes the Payoffpak fibre drum for handling and dispensing as much as 600 pounds of wire.

### Silicone Rubber Guide

**A** handy specifications guide for users of silicone rubber is now available from **General Electric's Silicone Products Department,** Waterford, N. Y.

* * *

**Identified** as CDS-188, this eight-page bulletin lists a wide variety of standard industry and military specifications which cover most application requirements. Designed to assist users of silicone rubber in selecting the specifications to most effectively meet their particular requirements, this publication summarizes current ASTM, AMS and military specifications.

### New ASA Standard on Recording Machines and Wire

**An** American Standard for home wire recorders has been published by the **American Standards Association.** Titled "American Standard Requirements for Magnetic Recording Instruments for The Home — Wire Size, Speed, Spools, Z57.4-1959," the publication insures that spools of recording wire manufactured to its specifications will work on standard wire recorders.

* * *

**The** new American Standard is the same as RETMA REC-131-A established by the Radio-Electronics-Television Manufacturers Association, now the Electronic Industries Association. The Institute of Radio Engineers, as sponsor of ASA sectional committee Z57, submitted the standard to ASA for approval.

* * *

**The** standard establishes wire speed in the machine, how the wire is to be wound on the spool, dimensions and tolerances of the spool, and wire diameter.

* * *

**It** is available at 25c a copy from the American Standards Association, Dept PR 93, 70 East 45th Street, New York 17, N. Y.

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**For more complete information, consult the annual Wire and Wire Products Buyer's Guide. Only advertisers who have contracted for six or more insertions are listed in this section.**

**ABRASIVES—**
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Norton Co., Worcester, Mass.

**ACID INHIBITORS—**
(See Inhibitors, Pickling)

**ANNEALING MACHINES — Electric Resistance**
Syncro Machine Co., Perth Amboy, N. J.

**ANNEALING POTS AND BOXES—**
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.

**BAKERS—**
(See OVENS—Rod Bakers)

**BOBBINS—Braider & Wire Weaving**
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**BORAX—Wire Drawing**
United States Borax & Chemical Corp., Pacific Coast Borax Co. Div., New York, N. Y.

**BORON CARBIDE—**
Norton Co., Worcester, Mass.

**CABLE FILLERS—Paper**
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
Twitchell, Inc., E. W., Philadelphia, Pa.

**CAPSTANS—for Wire (also Caterpiller Types)**
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Davis Electric Co., Wallingford, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Kraft, J. A. Maschinenfabrik, OLPE/Westf., Germany
Larmuth & Bulmer Limited, Manchester, England

**CARRIERS—Braider, High Speed**
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**CASTINGS—Wire Mill**
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.

**CEMENTS—Refractory**
Norton Co., Worcester, Mass.

**CLEANERS—Metal**
Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Phila., Pa.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Parkin Chemical Co., The, Pittsburgh, Pa.
Standard Industrial Compounds Co., Frankfort, Ill.

**CLEANING & PICKLING EQUIP.—**
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, Ohio
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

**CLOTH—WIRE, All Metals**
Wickwire Bros., Cortland, N. Y.

**COATING COMPOUNDS—**
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N. Y
Miller, R. H., Co., Homer, N. Y.
Parker Rust Proof Co., Detroit, Michigan
Standard Industrial Compounds Co., Frankfort, Ill.
United States Borax & Chemical Corp., Div. Pacific Coast Borax Co., New York, N. Y.

**COLOR CONCENTRATES—For Wire Coatings**
Blane Corporation, The, Canton, Mass.
Century Dispersions, Inc., Detroit, Mich.

**COMPOUNDS—Coppering**
Amchem Products, Inc., Ambler, Pa.
Miller, R. H. Co., Inc., Homer, N. Y.

**COMPOUNDS—Diamond (Pre-Mixed)**
Eastern Carbide Corp., New Rochelle, N. Y.
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Rusch Wire Die Corporation, Croton-on-Hudson, N. Y.

**COMPOUNDS—Extrusion, for Wire**
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.

**COMPOUNDS—For Improving Drawing & Extrusion**
Amchem Products, Inc., Ambler, Pa.

**COMPOUNDS—Metal Finishing**
Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parker Rust Proof Co., Detroit, Michigan

**COMPOUNDS—Phosphate Coating**
Amchem Products, Inc., Ambler, Pa.
Parker Rust Proof Co., Detroit, Michigan

**COMPOUNDS—Rust Preventing**
Amchem Products, Inc., Ambler, Pa.
American Lanolin Corporation, Lawrence, Mass.
Apex Alkali Products Co., Philadelphia, Pa.
Parker Rust Proof Co., Detroit, Michigan

**COMPOUNDS—Rust Removing**
Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N. Y.
Nopco Chemical Co., Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

**COMPOUNDS—Vinyl**
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
General Tire & Rubber Company, The, Akron, Ohio
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

**COMPOUNDS—Wire Drawing**
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.
Swift & Company, Chicago, Ill.
United States Borax & Chemical Corp., Pacific Coast Borax Co. Div., New York, N. Y.

**CONDUCTORS—Flexible, Electrical**
Montgomery Co., The, Windsor Locks, Conn.

**CONTAINERS—Wire Packaging**
(See DRUMS—Wire Packaging)

**COPHOLDERS—Steel**
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**CORDS—Electrical, Tinsel Conductor**
Montgomery Co., The, Windsor Locks, Conn.

**COUNTERS—**
(See MACHINERY—Measuring Wire and Cable)

**CRANES—Wire Mill**
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

**CUTTING TOOLS—Carbide**
Eastern Carbide Corp., New Rochelle, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.

**CUTTING TOOLS—Wire**
Porter, H. K., Inc., Somerville, Mass.
Robinson, M. W. Co., Rockville, Conn.

**DIAMONDS—Industrial**
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

**DIAMOND POWDERS—**
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Fort Wayne Diamond Products, Inc., Fort Wayne, Indiana
Hoosier Wire Die, Inc., Ft Wayne, Ind.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

**DIAMOND POWDER RECLAIMING—**
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Fort Wayne Diamond Products, Inc., Fort Wayne, Indiana
Hoosier Wire Die, Inc., Ft Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

**DIAMOND TOOLS—**
Indiana Wire Die Co., Ft. Wayne, Ind.
Wayne Wire Die Co., Linden, N. J.

**DIES—Carbide, Tungsten & Tantalum**
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

**DIES—Cold Heading**
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France

**DIES—Diamond**
Ajax Industrial Supplies, Inc., Ft. Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Ft. Wayne Wire Die Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

**DIES DIAMOND—Reversible**
Indiana Wire Die Company, Fort Wayne, Indiana
National Wire Die Co., Inc., New York, N. Y.

**DIES—Extrusion**
Central Tool and Machine Co., Bridgeport, Conn.
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France.
Rusch Wire Die Co., Croton-on-Hudson, N.Y
Wayne Wire Die Co., Linden, N. J.

**DIES—Eyelet**
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.

**DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.**
Pittsburgh Carbide Die Co., Monongahela, Pa.

**DIES—Pointing**
Sjogren Tool and Machine Co., Auburn, Mass.

**DIES—Repairs & Re-Cutting**
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.

Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

**DIES—Roll Threading**
Rivom, Dijon, France

**DIES—Special Shapes, Etc.**
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Rivom, Dijon, France

**DIES—Swaging**
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

**DIES—Tinning**
Roux Wire Die Works, Inc., Oriskany, N. Y.

**DIES—Tube Drawing**
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Hoosier Wire Die., Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France
Rusch Wire Die Corp., Croton-on-Hudson, N. Y

**DRAW BENCHES—**
(See MACHINERY)—Draw Benches)

**DRUMS—Wire Packaging**
Hubbard Spool Company, Div., The American Pulley Co., Garrett, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

**DRUMS & TRAVERSES—For Cable Reels**
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Republic Steel Corp., Berger Div., Canton, Ohio

**DRYING EQUIPMENT—**
Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A. Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

**EYELETS—Brass or Zinc**
Platt Bros. & Co., The, Waterbury, Conn.

**FOAM PRODUCING COMPOUNDS—**
Amchem Products, Inc., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

**FURNACES—Brazing**
Ajax Electric Company, Philadelphia, Pa.
Harper Electric Furnace Corporation, Buffalo, N. Y.
Sunbeam Equipment Corporation, Meadville, Pa.

**FURNACES—Galvanizing Equipment**
Ofenbau Fritz, G.m.b.H. & Co., K. G., Hagen (W. Germany)
Sunbeam Equipment Corporation, Meadville, Pa.
Wilson, Lee, Engr. Co., Cleveland, Ohio

**FURNACES—Heat Treating**
Ajax Electric Company, Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Harper Electric Furnace Corporation, Buffalo, N. Y.
Ofenbau Fritz, G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Sunbeam Equipment Corporation, Meadville, Pa.
Wilson Lee Engr. Co., Cleveland, Ohio

**FURNACES—Pot (Oil, Gas, Electric)**
Ajax Electric Company, Philadelphia, Pa.
Ofenbau Fritz, G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Sunbeam Equipment Corporation, Meadville, Pa.

**FURNACES—Resistance Heating, Strand**
Harper Electric Furnace Corporation, Buffalo, N. Y.
Sunbeam Equipment Corporation, Meadville, Pa.

**FURNACES—Salt Bath**
Ajax Electric Company, Philadelphia, Pa.

**FURNACES—Strand Annealing**
Ajax Electric Company, Philadelphia, Pa.
Harper Electric Furnace Corporation, Buffalo, N. Y.
Ofenbau Fritz, G.m.b.H. & Co. K. G., Hagen, (W. Germany)
Sunbeam Equipment Corporation, Meadville, Pa.

**GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)**

**GRINDERS—Roll**
Norton Co., The, Worcester, Mass.

**GUIDES—For Wire**
Heany Industrial Ceramic Corp., New Haven, Conn.

**GUIDE TIPS—For Extruding Machines (See NOZZLES)**

**HAMMERS—Nail Heading**
Pittsburgh Carbide Die Co., Monongahele, Pa.

**HAMMERS—Swaging**
Sjogren Tool and Machine Co., Auburn, Mass.

**HOISTS—Electric Travelling**
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

**INHIBITORS—Pickling**
Amchem Products Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

**INKS—Printing, for Insulated Wire**
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

**INSULATING MATERIALS—**
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
General Tire & Rubber Company, The, Akron, Ohio
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, Naugatuck, Conn.

**LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire**

**LAME—LAHN—**
Montgomery Co., The, Windsor Locks, Conn.

**LIME—**
Warner Co., The, Philadelphia and Bellefonte, Pa.

**LUBRICANTS—For Metal Cutting, Stamping and Drawing**
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

**LUBRICANTS—Wire Drawing**
(See Compounds—Wire Drawing)

**LUBRICANTS—Wire Rope**
Swift & Co., Chicago, Ill.

**MACHINERY—Armoring (Cable, Wire, Hose)**
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

**MACHINERY—Barbed Wire**
Glader Wm., Machine Works, Chicago, Ill.
Takemura & Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

**MACHINERY—Bobbin Winders**
Associated American Winding Machinery, Inc., New York, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Larmuth and Bulmer, Limited, Manchester, England

**MACHINERY—Bolt, Rivet, Screw, etc.**
Boltmaster Co., The, Cleveland, Ohio
National Machinery Co., Tiffin, Ohio
Takemura & Co., Ltd., New York, N. Y.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Braiding**
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Bunching**
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Bundling, Scrap**
Vaughn Machinery Co., Cuyahoga Falls, Ohio

**MACHINERY—Cable, Electric**
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)**

**MACHINERY—Centerless Grinding & Polishing**
American Laubscher Corporation, New York, N. Y.

**MACHINERY—Chain Link Fence**
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Steel & Wire Machinery Co., Cleveland, Ohio

**MACHINERY—Chain Making**
Larmuth and Bulmer, Limited, Manchester, England
Pan American Supply Company, New York, N. Y.
Steel & Wire Machinery Co., Cleveland, Ohio
Wafios Machinery Corp., Hackensack, N. J.

**MACHINERY—Closing Cable**
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N.J.

**MACHINERY—Coiling Rod**
Vaughn Mach'y Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Cold Heading**
Boltmaster Co., The, Cleveland, Ohio
National Machinery Co., Tiffin, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Copper Wire Drawing**
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn, Maschinenfabrik, Herborn, Germany
Morgardshammars Mek Verkstads A. B., Morgardshammar, Sweden
National Mach'y Exch (Used), New York
Showa Machine Works, Ltd., Osaka, Japan
Steel & Wire Machinery Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)**

**MACHINERY—Cutting**
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Pan American Supply Company, New York, N. Y.
Wire Machinery, Inc., Chicago, Ill.

**MACHINERY—Dead Block (Stationary Coiler)**
Morgan Construction Company, Worcester, Mass.
Wells Company, Frank L., Kenosha, Wisc.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wire Machinery, Inc., Chicago, Ill.

**MACHINERY—Descaling Rod, Dry**
Fisher Associates, New York, N. Y.
Herborn, Maschinenfabrik, Herborn, Germany
Pangborn Corporation, Hagerstown, Md.
Wire Machinery, Inc., Chicago, Ill.

**MACHINERY—Diameter Control**
Daystrom-Weston, Industrial Gauges, West Englewood, N. J.

**MACHINERY—Die Making**
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Sjogren Tool & Machine Co., Auburn, Mass.
Wayne Wire Die Co., Linden, N. J.

**MACHINERY—Draw Benches**
American Laubscher Corporation, New York, N. Y.
General Machine Tool Co., Worcester, Mass.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Wire Machinery Inc., Chicago, Ill.

**MACHINERY—Edging (See MACHINERY—Tandem Rolling and Edging Mills)**

**MACHINERY—Enameling**
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

**MACHINERY—Extruding**
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Royle, John. & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc (used) Pawtucket, R. I.

**MACHINERY—Fence**
Glader, Wm., Machine Works, Chicago, Ill.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Wafios Machinery Corp., Hackensask, N. J.

**MACHINERY—Flat Wire**
General Machine Tool Co., Worcester, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Stanat Manufacturing Co., Inc., Westbury, L. I., N. Y.
Steel Equipment Company, Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.

**MACHINERY—Forming Wire**
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

**MACHINERY—Galvanizing Wire**
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Steel & Wire Machinery Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wilson, Lee, Engr. Co., Cleveland, Ohio

**MACHINERY—Gang Winders**
Entwistle Manufacturing Corporation, Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Grinding**
Norton Co., The, Worcester, Mass.

**MACHINERY—Insulating Wire**
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Litzler, C A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Insulation Testing (See MACHINERY—Spark Testing)**

**MACHINERY—Lacquering Electric Wire**
American Insulating Mach'y Co., Philadelphia, Pa.
Cook Mfg. Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

**MACHINERY—Lock Washer**
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Looms, Wire Weaving**
EVG., Machinen & Stahl, A. G., Zurich, Switzerland

**MACHINERY—Material Handling**
(See Material Handling Equipment)

**MACHINERY—Measuring Diam., Insulated Wire**
Davstrom-Weston, Industrial Gauges, West Englewood, N. J.

**MACHINERY—Measuring Wire & Cable**
Davis Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wisc.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providene, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Nail and Tack**
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Co., Tiffin, Ohio
National Mach'y Exch. (Used), New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

**MACHINERY—Packaging Wire**
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Paper Clips**
Pan American Supply Company, New York, N. Y.

**MACHINERY—Patenting Wire**
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Pin Making**
Takemura & Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensask, N. J.

**MACHINERY—Plating**
Bartell Machine Tool Corp., Rome, N. Y.
Hodge Bros. Machine Shop, Ossining, N. Y.
Universal Industries Equipment Co., Secaucus, N. J.

**MACHINERY—Pointing**
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Printing on Electric Wire**
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

**MACHINERY—Re-Spooling**
Associated American Winding Machinery, Inc., New York, N. Y.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Machine Tool Co., Worcester, Mass.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
National Mach'y Exch. (Used), New York, N. Y.
Vaughn Machinery Co., Cuyahoga Fall, Ohio
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

**MACHINERY—Ring Forming**
Pan American Supply Company, New York, N. Y.

**MACHINERY—Rod Mill**
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.

**MACHINERY—Rolling Mill**
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Rubber Insulating**
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

**MACHINERY—Serving**
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

**MACHINERY—Slitting Mills**
Steel Equipment Company, Cleveland, Ohio

**MACHINERY—Special**
General Machine Tool Co., Worcester, Mass.

**MACHINERY—Spring Making**
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells Company, Frank L., Kenosha, Wisc.
Wafios Machinery Corp., Hackensack, N. J.

**MACHINERY—Staple Making**
Pan American Supply Company, New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

**MACHINERY—Straightening & Cutting**
American Laubscher Corporation, New York, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Patterson, George C. Machine Co., Cleveland Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wells Company, Frank L., Kenosha, Wisc.

**MACHINERY—Stranding**
Bartell Machine Tool Corp., Rome, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Krupp, Fried., Machinen-Und Stahlbau Rheinhausen, Germany
Larmuth & Bulmer Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Swaging**
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

**MACHINERY—Take-Up and Pay-Out**
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
American Insulating Mach'y Co., Phila., Pa.
Associated American Winding Machinery, Inc., New York, N. Y.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth & Bulmer Limited, Manchester, England
Litzler, C. A., Co., Inc., Cleveland, Ohio
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Taping**
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine) France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Thread Rolling**
Boltmaster Co., Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Wire Machinery, Inc., Chicago, Ill.

**MACHINERY—Tinning Wire**
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cook Manufacturing Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

**MACHINERY—Tinsel Rolling Mills**
American Insulating Mach'y Co., Phila., Pa.

**MACHINERY—Trolley Wire**
Torrington Mfg. Co., Torrington, Conn.

Vaughn Machinery Co., Cuyahoga Falls, Ohio

**MACHINERY—Tube Mill, Cold Drawing**
Mettler Machine Tool, Inc., New Haven, Conn.

**MACHINERY—Twinning**
(See Mach.—Bunching)

**MACHINERY—Twisters, Wire**
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cock Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

**MACHINERY—Used**
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.
Wire Machinery, Inc., Chicago, Ill.

**MACHINERY—Welded Wire Mesh**
EVG, Maschinen and Stahl, A.G., Zurich, Switzerland
Schlatter, Ltd., H. A., Zollikon/Zurich

**MACHINERY—Wire Weaving**
Takemura & Co., Ltd., New York, N. Y.

**MACHINERY—for Wire Welding**
(See WELDERS—Butt and Spot and Machinery—Welding Wire Fabrics)

**MACHINERY—Winding Wire**
Associated American Winding Machinery, Inc., New York, N. Y.
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Machine Tool Co., Worcester, Mass.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Watson Machine Co., Paterson, N. J.

**MACHINERY—Wire Drawing**
American Laubscher Corporation, New York, N. Y.
Atlas Polar Co., Ltd., Toronto, Ont., Canada
Cook Manufacturing Co., The, Paterson, N J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Morgan Construction Co., Worcester, Mass.
Morgardshammars Mek Verkstads AB, Morgardshammar, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Showa Machine Works Ltd., Osaka, Japan
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Wire and Machinery Co., Cleveland, Ohio
Superior Tool & Machinery Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Takemura Co., Ltd., New York, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wire Machinery Inc., Chicago, Ill.

**MACHINERY—Wire Forming**
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Takemura Co., Ltd., New York, N. Y.

**MACHINERY—Wire Rope**
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Wrapping with Paper**
American Laubscher Corp., New York, N. Y.
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Company, Boston, Mass.

**MATERIAL HANDLING EQUIPMENT—**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio

**NAIL TOOLING—Tungsten Carbide**
Pittsburgh Carbide Die Co., Monongahela, Pa.

**NAILS—Wire**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pan American Trade Development Corp. New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.

**NIPPERS—Wire Cutting**
Robinson, M. W. Co., Rockfall, Conn.

**NOZZLES—For Extruding Machines**
Central Tool and Machine Co., Bridgeport, Conn.

**OVENS—Cable Lacquering and Enameling**
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Michigan Oven Company, Detroit, Mich.

**OVENS—Rod Bakers**
Carl Mayer Corp., The, Cleveland, Ohio

**OVENS—Welding Rod Coating**
Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

**PAILS—Packaging**
**(See Drums—Wire Packaging)**

**PAINT BONDING CHEMICAL**
Amchem Products, Inc., Ambler, Pa.

**PAINTS—Heat Resisting**
Amchem Products, Inc., Ambler, Pa.

**PAPER—Insulating**
Twitchell, Inc., E. W., Philadelphia, Pa.

**PAY-OUT SYSTEMS—**
(See MACHINERY—Take-Up & Pay-Out)

**PHOSPHATE COATING CHEMICALS**
(See COMPOUNDS—Phosphate Coating)

**PICKLING COMPOUNDS—**
See (Inhibitors—Pickling)

**PLASTICIZERS—**
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

**PLASTICS—for Wire Insulation**
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, Naugatuck, Conn.

**PRINTING WHEELS—for Electric Wire**
Daniels & Co., Frank, New York, N. Y.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., Inc., West Hanover, Mass.
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

**PULLERS AND GRIPS—For Wire**
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

**RACKS—Wire Storage**
Jarke Manufacturing Co., Chicago, Illinois

**REEL AND TENSION STANDS—**
Mettler Machine Tool, Inc., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

**REEL CRUTCHES—**
Watson Machine Co., Paterson, N. J.

**REELS & SPOOLS—Aluminum Alloy**
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett ,Ind.
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS & SPOOLS—Annealing and Stranding**
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Berger Div., Canton, Ohio
Wood's Sons Company, T. B., Chambersburg, Pa.

**REELS—Metal Bound**
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.

**REELS—Plywood**
Carris Reels, Inc., Rutland, Vt
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.

**REELS & SPOOLS—Steel (All Types)**
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
New York Engineering Corp., Yonkers, N. Y.
Republic Steel Corp., Berger Div., Canton, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS—Steel, for Rope and Cable**
New York Engineering Corp., Yonkers, N. Y.

**REELS—Wire Mill**
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Nelson Co., The, Baltimore, Md.
Republic Steel Corp., Berger Div., Canton, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Woodcraft Company, Bay City, Michigan

**REELS & SPOOLS—Wood**
American Wood Working Co., Montello, Wisc.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Nelson Co., The, Baltimore, Md.
Woodcraft Company, Bay City, Michigan

**REFRACTIONS—High Temperature**
Norton Company, Worcester, Mass.

**ROD BAKERS—**
(See OVENS—Rod Bakers)

**RODS—Stainless Steel**
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.

**RODS—Wire—Non-Ferrous**
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.

**RODS—Steel**
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Niederrheinische Huette, A. G., Duisburg, Germany
Pan American Trade Development Corp. New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

**ROLLS—For Flattening Wire**
General Machine Tool Co., Worcester, Mass.

**ROPE—Wire**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons, Div. Colorado Fuel & Iron Corp., Trenton, N. J.

**RUST PROOF COMPOUNDS—**
(See COMPOUNDS—RUST Removing)

**RUST REMOVING COMPOUNDS—**
(See COMPOUNDS—RUST Preventing)

**SATURATION SYSTEMS—**
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

**SOAPS—Industrial and Wire Drawing**
(See COMPOUNDS—Wire Drawing)

**SPOOLS—Plastic**
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.

**STAMPINGS—Steel**
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

**STOCK STORAGE SYSTEMS**
Jarke Manufacturing Co., Chicago, Illinois

**STRIP—Steel**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div. Colorado Fuel & Iron Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, Ohio

**TANKS—Ceramic, for Galvanizing**
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, W.-Germany)

**TANKS—Compound**
Watson Machine Co., Paterson, N. J.

**TENSION METERS—for Wire**
Boulin Instrument Corporation, Pelham, N. Y.
Tensitron, Inc., Harvard, Mass.

**TESTERS—INSULATION**
(See Testing Equipment—for Dielectric Faults)

**TESTING EQUIPMENT — Dielectric Faults in Insulation**
Davis Electric Co., Wallingford, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Peschel Electronics, Inc., Patterson, N. Y.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

**TESTING EQUIPMENT — Physical**
Scott Testers, Inc., Providence, R. I.

**TINSEL—Electric Conductor**
Montgomery Co., The, Windsor Locks, Conn.

**TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.**
(See TINSEL—Electric Conductor)

**TOOLS—Nail Machine**
Pittsburgh Carbide Die Co., Monongahela, Pa.

**TRAMRAIL SYSTEMS—**
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

**TRANSMISSIONS—Variable speed (See Adjustible Speed Drives)**

**TRAVERSES & DRUMS—For Reels**
(See Drums & Traverses)

**TRAVERSE MECHANISMS—**
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Hodge Bros. Machine Shop, Ossining, N. Y.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**VARNISHES & LACQUERS—for Electric Wire**
General Electric Company, Insulating Materials Section, Schenectady, N. Y.

**VULCANIZING PANS AND EQUIPMENT—**
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

**WAXES—for Insulated Wire**
Cary Chemicals, Inc., New Brunswick, N. J.

**WELDERS—Spot and Butt and Welding Wire Fabrics**
Eisler Engineering Corp., Newark, N. J.
EVG, Maschinen and Stahl, A.G., Zurich, Switzerland
Micro Products Co., Chicago, Ill.
Schlatter, Ltd., H. A., Zollikon-Zurich

**WHEELS—for Printing on Electric Wire**
Daniels & Co., Frank, New York, N. Y.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M., Co., Inc., West Boylston, Mass.

**WIRE—Aluminum**
Malin & Co., The, Cleveland, Ohio
Scovill Mfg Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Ball**
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Barbed**
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

**WIRE—Brass and Bronze**
Malin & Co., The, Cleveland, Ohio
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Bunched and Stranded**
Camden Wire Company, Camden, N. Y.

**WIRE—Cadmium**
Stamford Processing Co., Peekskill, N. Y.

**WIRE—Cast**
Youngstown Sheet & Tube Co., Youngstown, Ohio

**WIRE—Cold Heading**
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

**WIRE—Copper**
Camden Wire Company, Camden, N. Y.
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

**WIRE—For Electrical Conductors**
Camden Wire Company, Camden, N. Y.
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Flat**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Jones & Laughlin Steel Corp, Stainless and Strip Div., Detroit, Mich.
Montgomery Co., The, Windsor Locks, Conn.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Galvanized**
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado, Fuel & Iron Corp., New York, N. Y.

**WIRE—High Carbon**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Detroit Steel Corporation, Detroit, Mich.
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Manufacturers**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Marathon Specialty Steels, Inc., New York, N. Y.
National Lock Washer Company, The, Newark, N. J.
Pan American Trade Development Corp., New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Berger Div., Canton, Ohio
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

**WIRE—Metalizing**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Platt Bros & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

**WIRE—Music**
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio

**WIRE—Needle**
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Nickel Alloy**
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Nickel Silver and Phosphor Bronze**
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

**WIRE—Oil Tempered**
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
Pan American Trade Development Corp., New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Special Shapes**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
National Lock Washer Company, The, Newark, N. J.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Spring**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Marathon Specialty Steels, Inc., New York, N. Y.
Pan American Trade Development Corp., New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

**WIRE—Stainless Steel**
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Malin & Co., The, Cleveland, Ohio
National Lock Washer Company, The, Newark, N. J.
Nippon Stainless Steel Wire Mfg. Co., Ltd., Osaka, Japan
Pan American Trade Development Corp., New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

**WIRE—Steel—Also Coppered and Galvanized Steel**
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Malin & Co., The, Cleveland, Ohio
Pan American Trade Development Corp., New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

**WIRE—Straightening and Cutting**
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

**WIRE—Upholstery and Mattress**
Pan American Trade Development Corp., New York, N. Y.

**WIRE—Zinc**
Platt Bros. & Co., The Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

**WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.**

**WRAPPING PAPER—Creped**
(See PAPER—Creped Wrapping)

**YARN TESTERS—**
Scott Testers, Inc., Providence, R. I.

**YARNS—Wire Insulating**
Synthetic Thread Co., Bethlehem, Pa.

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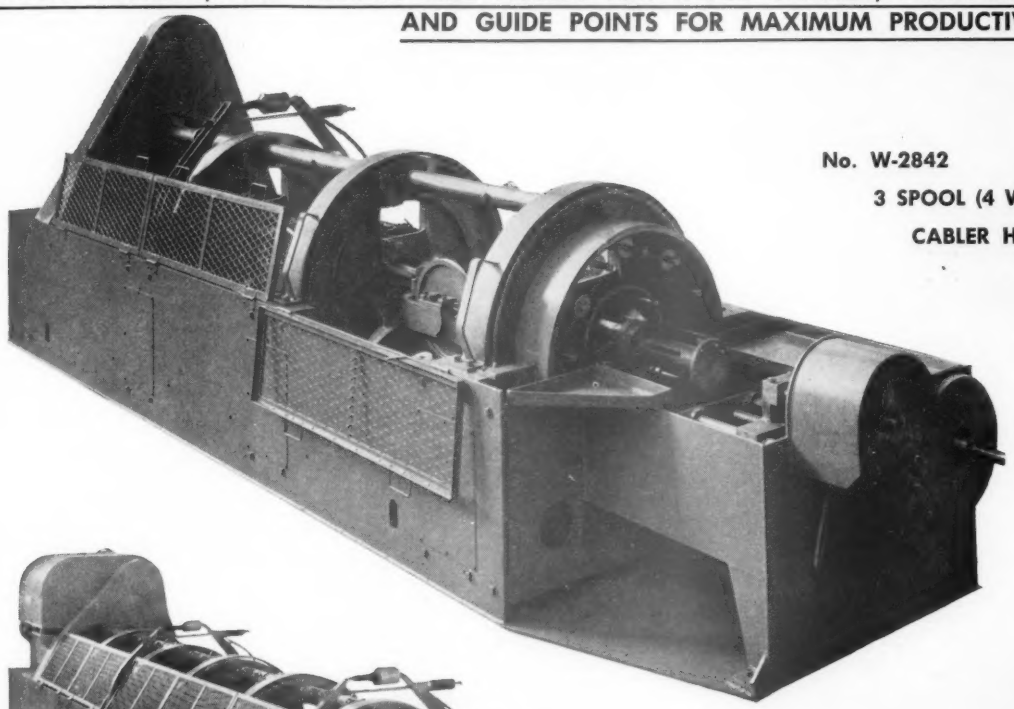

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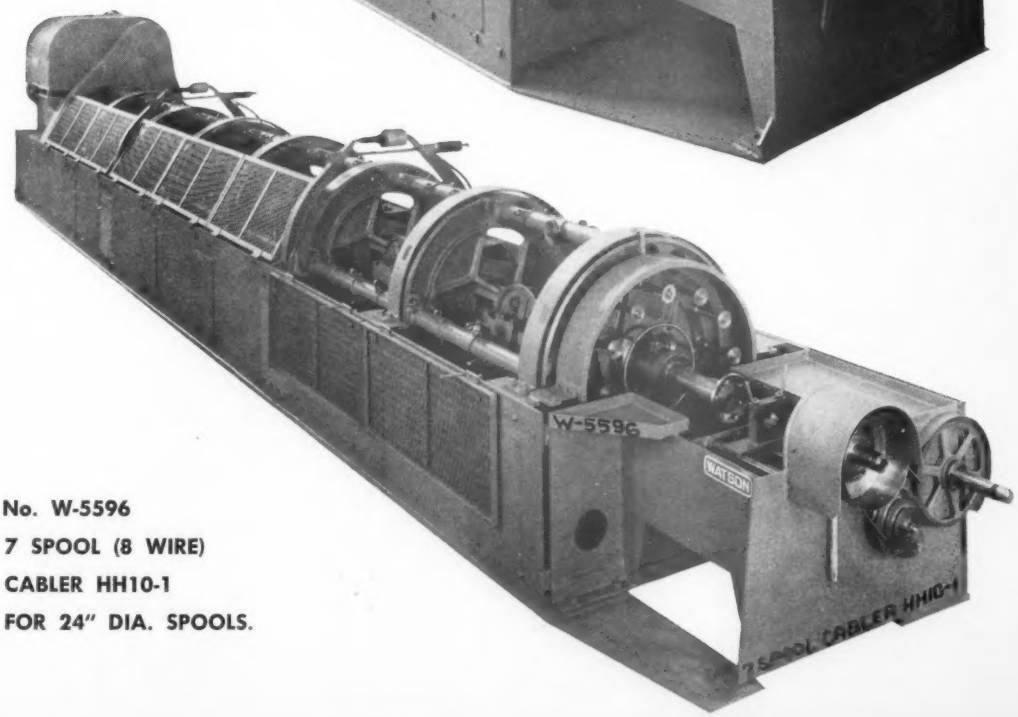


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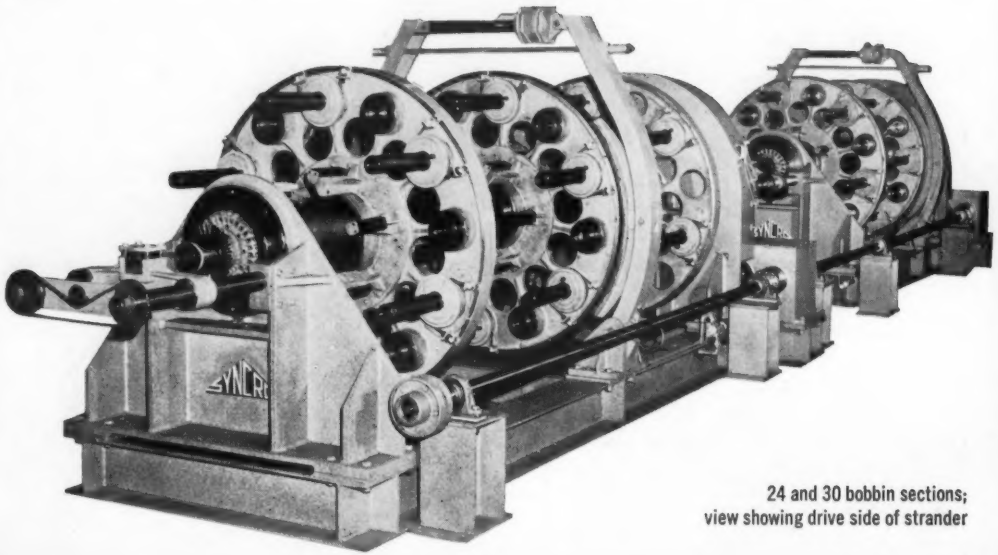


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